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THESIS

Budgetary Control in a Manufacturing Concern

by

Henry Alden Dean
(A.B. Boston College 1938)

submitted in partial fulfillment of
the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

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A DEDICATION

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To

Former Associates and

Friends of Long Standing

at New Departure Division of

General Motors, Meriden, Connecticut

Whose Willing Assistance and Gracious Courtesy

Made this Treatise Possible

****

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Chapter 1. Introduction

FOREWORD

There is a growing tendency today in cost accounting circles toward making accounting less historical, and more dynamic; dealing not solely with facts which are past, happened, and therefore dead, but also with forecasted future events regarding which there is yet time to take action; and turning the accountant from the role of historian, to that of forecaster, advising business on current and future policies relating to the accounting field. Concurrent with and closely allied to this movement is developing the idea of fingertip control of expense through the analysis of accounting data and the medium of controlling reports by virtue of which a clear picture of plant performance and efficiency is afforded the accountant, so that he is enabled weekly, yes, and even daily to ascertain whether, in comparison with the forecasted program, the actual progress of the plant is favorable or unfavorable.

RESPONSIBILITIES OF THE ACCOUNTANT

Budgetary Control is a twofold problem, vitally concerning not only management, but also the accounting department; consequently it is appropriate at this time to enlarge upon the responsibilities of the accountant in the operation of the system of control. J. Brooks Heckert in his text entitled "Business Budgeting and Control"[1] has expressed it very well. The accountant does not originate the budget nor lay down the policies of the

1. Heckert, J. Brooks, Business Budgeting and Control, New York, The Ronald Press Company, 1946. Chapter 2, Page 22.

control system, rather this is the duty of management. On the other hand, the accountant is in charge of the operation of the control system, its procedure and development. The emphasis is not upon what has happened, but rather upon what is happening, what will happen, and how well does performance conform to the most efficient operation of the plant or business. The accountant prepares the necessary forms, schedules, and other reports connected with the budgetary procedure, making any suggestions or revisions that will improve them. It is his duty to supply all executives and officers of the company with an accurate analysis of past operations, assist in determining future policies, and aid in the interpretation of the data presented. Detailed policies and plans of management are transposed by the accountant into detailed budgetary requirements, and broken down into monthly, weekly, or even daily periods. He keeps the executives informed as to the execution of the budget, analyzes the variances between budgeted and actual results, and develops them as to their causes and effects. He initiates prompt revision of the budget when circumstances require it, and thus maintains a well-coordinated program. In short, it is for management to propose, and for the accountant to dispose.

The idea of Budgetary Control has been defined by the National Industrial Conference Board[1] as the assembling of information that may have an effect on the operations of an industrial enterprise during a stated ensuing period, and the applying of the information to forecast

1. Budgetary Control in Manufacturing Industry, National Industrial Conference Board, New York, 1931. Page 11.

trends and to formulate a program, and finally the using of the program currently for measuring operations. In their book dealing with this same subject[1], Rowland and Harr have defined budgetary control as to its purposes and accomplishments. They call it the tool of management, which is used to plan, carry out, and control the operation of a business. The system establishes predetermined objectives, and enables the business to determine the need for modification of its plans when the occasion arises during the period, without waiting for the closing statements to be prepared at the end of the year, at which time it is too late to alter the company's position for the period just closed.

DEFINITION OF THE TERM

This idea of controlling the destinies of a company, and attempting to determine beforehand in a certain scientific manner a course of action, got its greatest impetus in private industry at the close of the First World War. However the concept was not a new one, but rather the adaptation to the needs of business of an idea already being worked out for public organizations, city, state, and national governments. Shortly after the turn of the century, attempts were made to reform the municipal government and combat the high cost of running the cities, thus reducing the amount of graft and improper use of public funds indulged in by unscrupulous politicians. Bureaus were therefore formed for the purpose of studying a reorganization of the existing systems. Among the states, the idea took hold around 1911, when the success of some cities in employing this control system became apparent, and by 1919 all states had some form of administration

HISTORICAL DEVELOPMENT OF BUDGETARY CONTROL

1. Rowland, Floyd H., and William H. Harr, Budgeting for Management Control, New York and London, Harper and Bros., 1945. Page 1.

of public funds. The National Government took up the matter when in 1909 President Taft appointed a committee to inquire into the methods of transacting the public business. In 1912 the committee submitted a report to Congress citing the need for a national budget. It was not until 1921, however, that the Budget and Accounting Act was passed, and the first National Budget relating to the fiscal year ending June 30, 1923 was sent to Congress for passage.

With the deflation of 1920, many leaders in industry saw the need for some system of financial estimates and forecasts for a better control of all phases of business. It was proposed that possible sales be forecasted, based on a figure consistent with plant capacity and financial resources. It would however of necessity have to be more flexible than public funds to compensate for changing market conditions, supply of materials, fluctuations in customer orders and buying power. Under the auspices of the International Management Institute, an international conference was held at Geneva, July 10-12, 1930, to study budgetary control. Seven industries took part in the discussions which did much to bring out new ideas and crystallize the problems at issue. The movement for better control of all the activities of business was gaining momentum, as private interests saw the tremendous value of this for raising plant efficiency and increasing profits.

The benefits that have resulted from this movement toward some form of operational control have been cited by the National Industrial

Conference Board[1]. A basis is provided for overall control of business operations and future operating policies. Close coordination is afforded with a view to synchronizing the activities in widespread branches of the larger companies, and, in the case of individual plants, the activities of the various departments. Finances, sales, and production are closely allied and the result is economy of effort through avoidance of losses due to excessive production, insufficient sales for the level of operations, or idle capital because of over-financing. It follows that the sales program is set up with an eye for its fulfillment. Production is keyed to the sales effort and planned so that seasonal variations offer a minimum of disturbance to operations and employment. Close control of inventories avoids losses due to high storage costs and capital tied up and consequently idle. Prices can be made so as to ensure recovery of capital in proportional amounts on every item sold. In short, such controls build up a goal toward which every effort is directed, ensuring maximum efficiency, reduced costs and expenses, and adequate income.

BENEFITS OF BUDGETARY CONTROL

And now, from the foregoing remarks of a general and introductory nature, turn to a few words on the scope of the thesis and the treatment to be given the subject. Part I deals with the development of the budget, beginning with the market survey, preparation of the data, and the steps in building up the individual budget programs. The second chapter is a closer study of how to set up controls

SCOPE OF THE THESIS

1. Budgetary Control in Manufacturing Industry, National Industrial Conference Board, New York, 1931. Page 12.

for the variable expenses. Part II is the application of the control program for variable expenses to the Meriden Plant "D" of New Departure Division of General Motors. Appendix A is a general discussion in a non-technical way of the manufacture of a ball bearing. It was felt that by the addition of Appendix A, a complete picture of this case study would be afforded the reader, since he would have therefrom a few ideas as to what a ball bearing looked like, and how it was made, and especially he would have some idea of the problems faced by the cost accountant when dealing with a ball bearing plant.

GENERAL SOURCES OF INFORMATION

The sources of data consisted mainly of three. The Introduction and Part I are based on writings dealing with budgetary control. The works of Rowland and Harr, The National Industrial Conference Board, Finney (Volume II), Blocker, Neuner, and Heckert were found to be most helpful. Part II is based on data gathered at the Plant along with two papers written by the Controller, Mr. Roszelle (See the bibliography). Appendix A is a synthesis of notes and data gathered during my term of employment with the cost department at Plant "D" coupled with two books published on New Departure by the Management, and included in the bibliography.

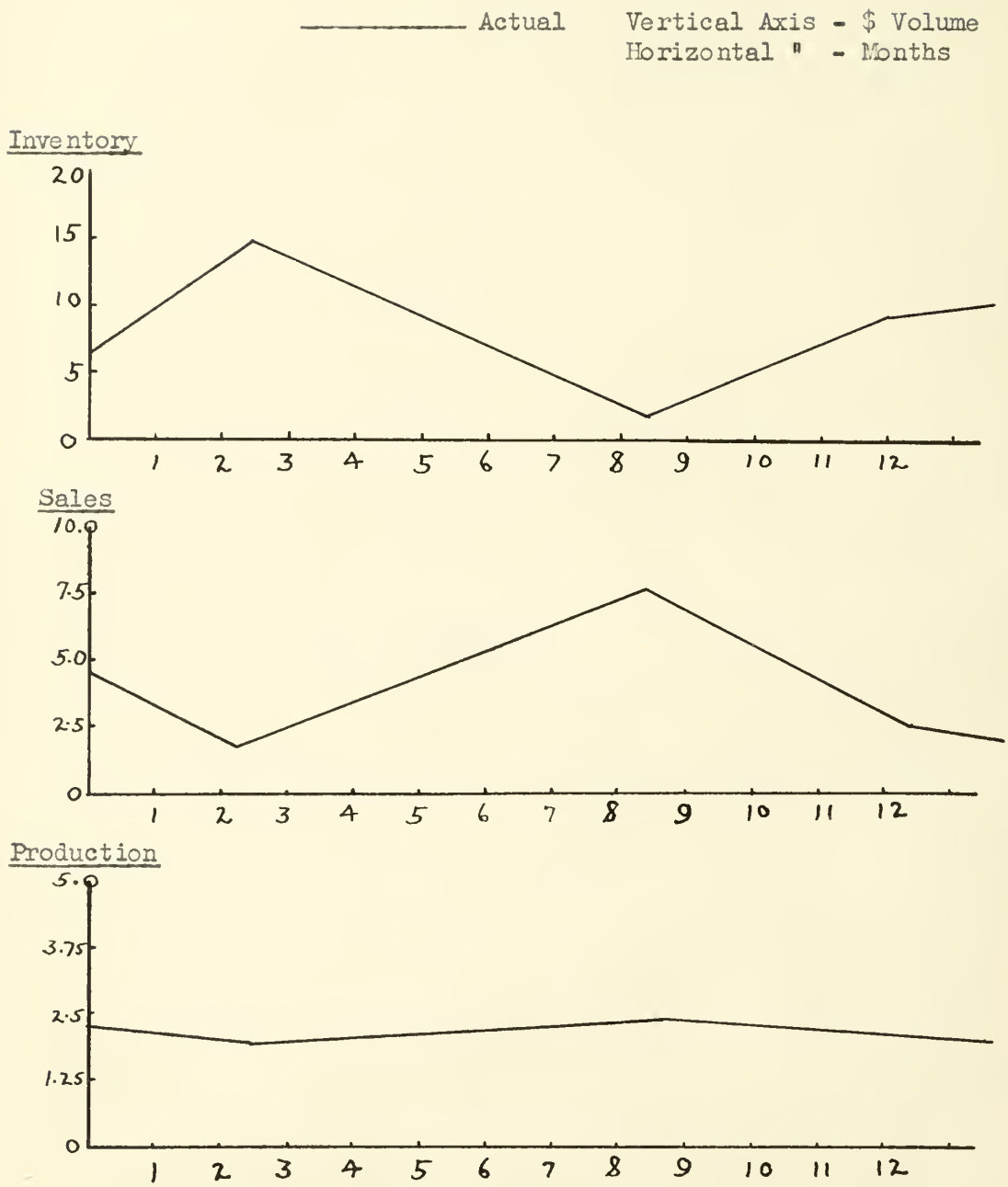
PART I

THEORY

OF

BUDGETARY CONTROL

Table I. Stabilization of Production



Source: Budgetary Control in Manufacturing Industry, National Industrial Conference Board, New York, 1931. Page 95. Adapted.

Opposite Page 9

PART I

Chapter 2. The General Budget

INTRODUCTION

Frederick Winslow Taylor had a phrase for it when he conceived his "Task Idea"[1]. Set up objectives, plan the method of attainment thoroughly, establish policies, and give the foreman something to strive for. With the full cooperation of all those concerned, a better control picture will evolve. Along with this same concept, Fred W. Shibley[2] postulates a new theory of forecasting. Instead of the old method of adding up the total sales income, deducting from it all costs and expenses and arriving finally at a net figure that may be profit or loss, he would first deduct from the total sales income a reasonable net profit, and then pare down all other costs and expenses to fit into the balance. To ensure that no expenses get out of line and distort the profit picture is the objective of budgetary control. Perfect synchronization of all activities throughout the concern is the ultimate goal.

John G. Blocker[3] emphasizes the leveling effect of budgeting

1. Taylor, Frederick W., The Principles of Scientific Management, New York and London, Harper and Bros., 1911. Page 39.

2. Shibley, Fred W., The New Way To Net Profits, New York and London, Harper and Bros., 1928. Page 133.

3. Blocker, John G., Cost Accounting, New York and London, McGraw-Hill Book Company, Inc., 1940, First Edition. Page 134.

Table II. First Budget to be Compiled

(Results of survey of 80 companies by NICB)

Sales	42
Production (incl mfg exp)	23
Selling Expense	1
Administrative Expense	2
Expense, not classified	5
Advertising	1
Capital Outlay	3
Cash	2
Profit and Loss	1
Total	80

In this survey conducted by the National Industrial Conference Board in 1930, out of the 80 firms contacted, 42 began setting up the budget with sales. The Production Budget was the second most frequently set up before any other.

Source: Budgetary Control in Manufacturing Industry, National Industrial Conference Board, New York, 1931. Page 54, Table 7.

Opposite Page 10

on the volume of production, and thence the economic gain accruing to the firm, labor, and the public (Table I). The relatively fixed elements of management and the investment in fixed assets should be operated at an even pace and at full capacity to obtain the greatest benefit. Executives attain greater efficiency when they work at a constant pace throughout the year, rather than being forced to work long hours under great strain during part of the year, only to idle along during the balance. Personnel costs tend to rise when it becomes necessary periodically to hire numbers of workers, train them, and later lay them off because of the seasonal decline. Profits are reduced through higher costs, demand falls off through reduced purchasing power on the part of the laborers. The necessity for adequate forecasting and accurate estimation of the volume of sales for the coming year becomes apparent. From the volume of sales can then be determined the required level of production to maintain inventories large enough to satisfy the demand of customers, the size of expenditures for material and equipment, and finally the amount of overhead necessary to produce the forecasted volume following logically. The sales forecast therefore is at the foundation of the entire budget structure, upon its accuracy depends the accuracy of the entire budgetary system; its importance cannot thus be underestimated (Table II).

Various techniques have been devised and tried leading to some sort of sales forecast. Certain well-established norms will be proposed at this time. J. Brooks Heckert devotes a chapter of his book to an

Table III. Origin of Budget Estimates

(Results of survey of 100 companies by the NICB)

In departments to which they relate	63
In accounting departments	16
In accounting departments (except sales)	7
Jointly	14
Total	100

The majority of the companies polled by the National Industrial Conference Board in 1930 originated their estimates in the department where the expense occurred.

Source: Budgetary Control in Manufacturing Industry, National Industrial Conference Board, New York, 1931. Page 52, Table 6.

Opposite Page 11

analysis of business conditions and its relation to the sales budget[1].

GENERAL BUSINESS SURVEY — Political and economic changes in the world affect business conditions in the community, abundance and scarcity of crops, inventions, war, governmental regulation of trade. Some companies rely on the personal judgment of their executives, others maintain their own economics department to appraise the future of the company in the light of the above conditions. A study is made of the company's position over many years, preferably at least fifteen to twenty, in relation to general business conditions. Data is gathered from trade and government publications, and from the files of the company. Decisions are then reached as to the trend of sales in the coming period.

In setting up the actual sales budget, breaking down the figures over the product lines and different territories, it was formerly the custom to have all the decisions originate from the central office. This often resulted in erroneous appraisal of the conditions in the field, and projected sales figures for territories would be unreasonably high or low. The present trend is toward having the forecasted figures originate in the field, with appraisals by the sales force as to future volume in the individual territory (Table III). These figures are then reviewed by the central office in the light of statistics giving the past performance of the company, data concerning present and future conditions in the industry and in general business, and finally data regarding conditions within the concern and its various territories. It is important that each

1. Heckert, J. Brooks, Business Budgeting and Control, New York, The Ronald Press Company, 1946. Chapter 7, Page 97ff.

territory receive a rational quota based on rational judgment; that no salesman be saddled with an insurmountable quota, while other men receive unreasonably light programs.

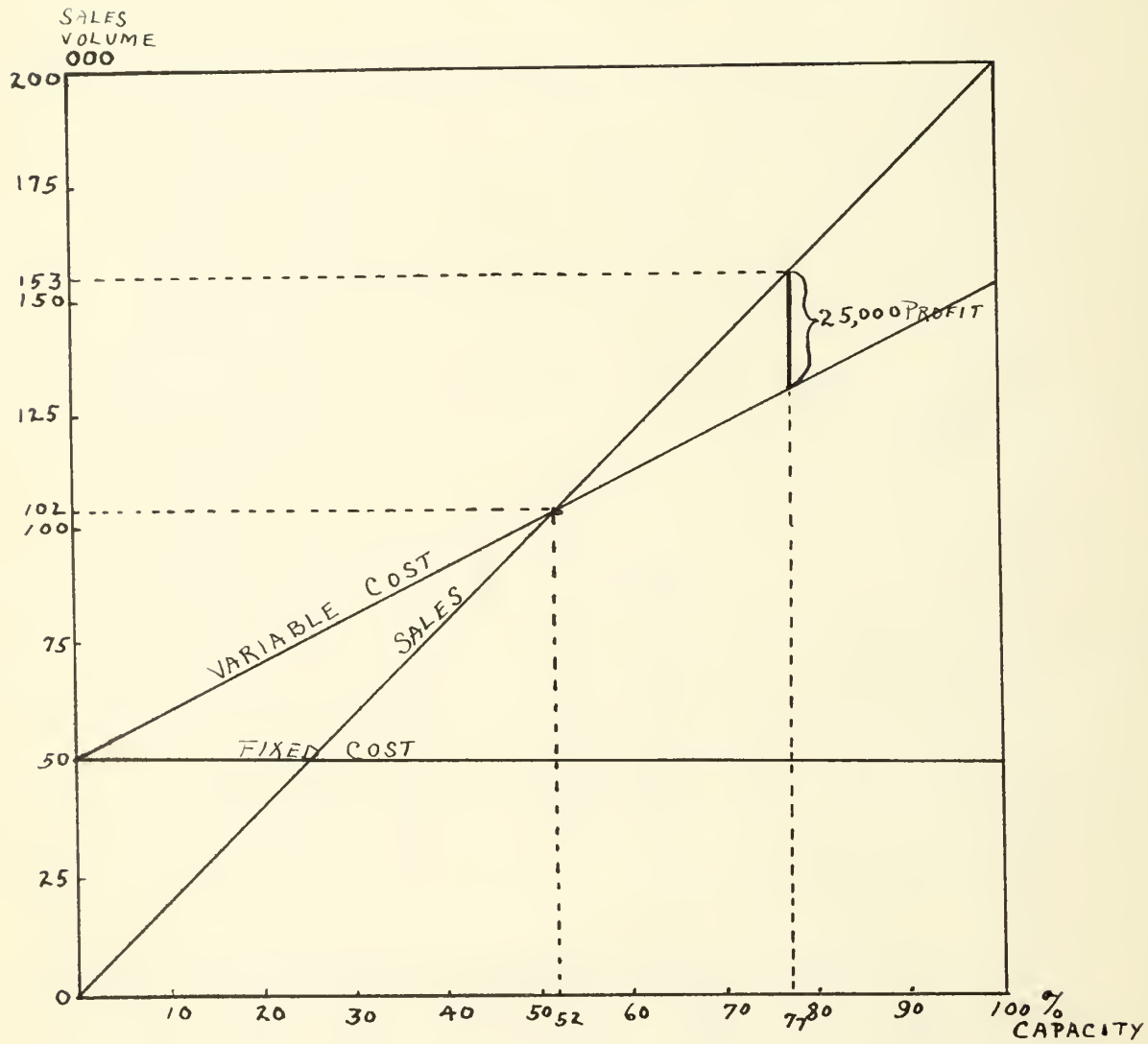
In connection with the assignment of quotas to individual territories or salesmen, a study is made of the past performance of each man in the light of the sales potentialities of the region. Such factors as the density of population, income rate, families, type of people who buy the product must be weighed. Similar territories should be assigned similar quotas. A study somewhat along the following lines might be in order:[1]

	Territory 1.	%	Territory 2.	%	Budget	%
Sales	$2000	100	$3000	100	$3000	100
Gross Margin	800	40	600	20	720	24
Selling Cost	400	20	900	30	600	20
Net	200	10	300	10	300	10

Columns one and two compare the performance of two men working in similar territories. The questions to be answered are whether #1 or #2 sales volume should be used for the budgeted figure in Column 3; whether the total net of $500 is a fair return, or whether a higher figure could be attained. It was decided in Column 3 that with sales of $3000,

1. Paton, W. A., Accountants' Handbook, Third Edition, Ther Ronald Press Company, New York, 1947. Page 1151, Section 21 (adapted).

Figure 1. Break Even Chart



Opposite Page 13

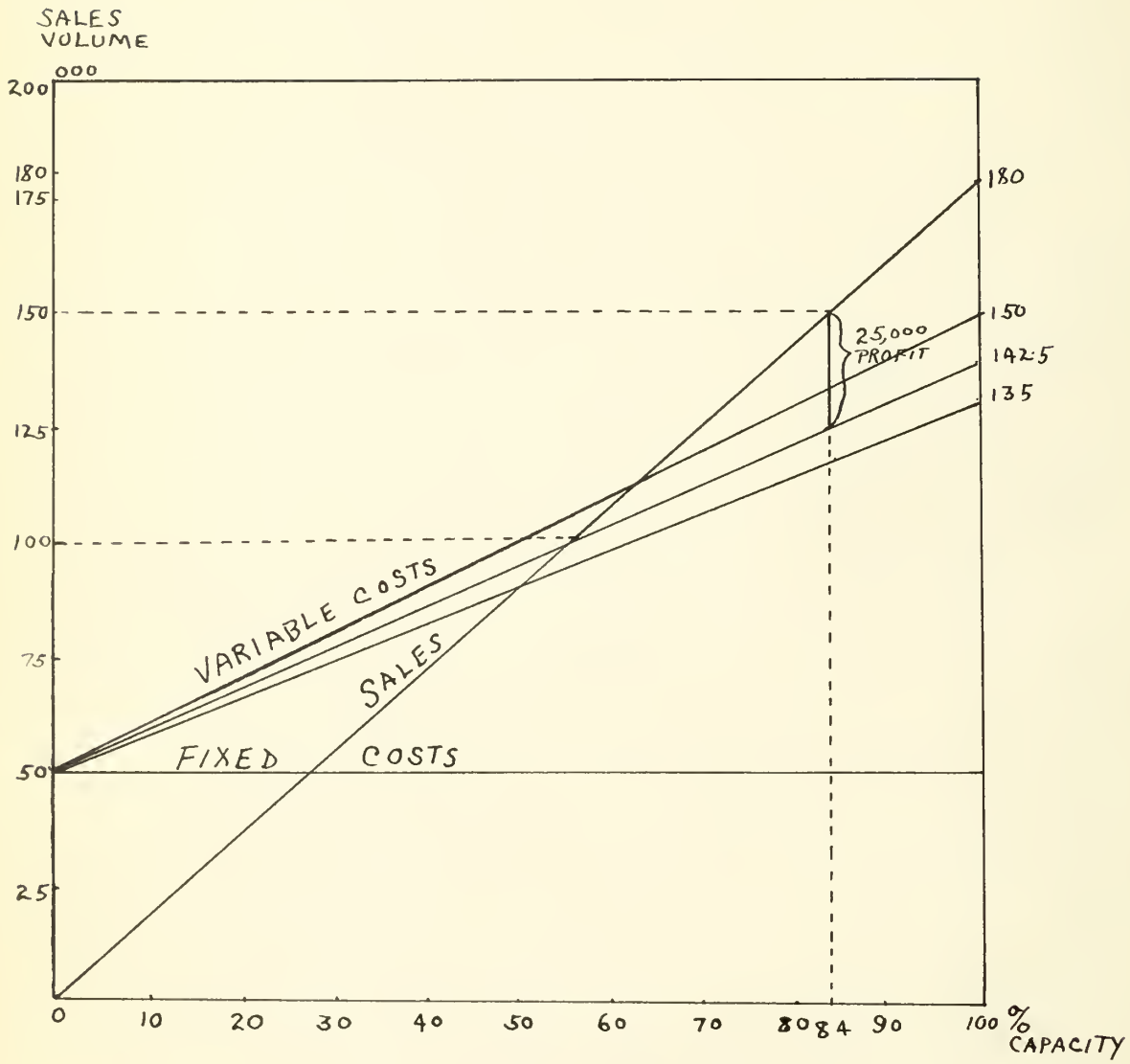
a 24% gross margin, 20% selling cost could be expected reasonably, and the net return total would be $600. A further study should be made of the difference in the sales performance between #1 and #2, with a view to correcting any inefficiencies.

BREAK-EVEN CHART

The Break-Even Chart (Figure 1) is helpful in establishing certain relationships between volume of sales, profits, and costs, and is of assistance in determining changes in the sales volume required by additions to capital assets, reduction of price, increase or decrease in volume of production. Following the theory of Shibley, it is proposed that a profit of $25,000 is considered reasonable for the period under study. Then, referring to the figure opposite, assuming fixed costs totaling $50,000, variable costs of $150,000, and sales volume of $200,000 at 100% capacity, a sales volume of $153,000 at 77% plant capacity is required to return a net profit of $25,000. With this tentative sales figure as a starting point, a survey is made of sales estimates by territories. If it is apparent that it will be improbable that the sales volume of $153,000 at 77% capacity will be attained, then revisions must be made in costs, prices, or level of operations to ensure that the profit figure will result.

The Chart can be made to show what changes to expect in a reduction of 10% in sales prices, assuming that the fixed costs remain the same, with thesame net profit figure of $25,000 as resultant. A problem arises at this point regarding the relationship of the variable costs to volume of production and money. At $200,000 sales volume and 100% plant

Figure 2. Break Even Chart



Source: Heckert, J. Brooks, Business Budgeting and Control, New York, The Ronald Press Company, 1946. Page 36. Adapted.

Opposite Page 14

capacity, the variable cost was $100,000 or 50% of sales volume. If the selling price is reduced 10%, the ratio of variable cost, if productive volume remains the same, to sales volume increases to 55%. However there is no change in the relation of variable cost to physical production. On the other hand, if productive volume is increased to counteract the drop in sales price, then, although the sales volume remains the same and there is no change in the ratio of variable cost to sales, the physical volume having increased changes the ratio of variable cost to physical production. To give effect to these changes, the chart on the opposite page (Figure 2) has three variable cost lines, the uppermost one being the variable cost with no change in productive volume (the condition existing in the foregoing example), the lowest line indicating the variable cost giving effect to a 10% reduction in volume of production, and the middle line indicating the variable cost if it is affected equally by money and by physical volume of production. Under this last condition, then, with a sales volume of $180,000, in order to net a profit of $25,000, a plant capacity of 84% and volume of sales of $150,000 is necessary.

By the use of formulae, the same results may be attained, and accordingly a series of assumptions are exemplified in Appendix B. It is possible to calculate the point at which the company will break even, in terms of plant capacity, or sales volume; the volume of sales that will yield a certain given profit; unit costs at different volume of sales; the increased sales volume necessary to balance a reduction in the selling price; the advisability of plant expansion.

Figure 3. Forecast of Sales

Product A

	Units	Sales Price	Amount
Territory 1	110	$50.	$5500.
" 2	100	50.	5000.
" 3	100	50.	5000.
" 4	120	50.	6000.
Total	430		$21500.

Opposite Page 15

When the estimated sales budget for the period under study has been finally accepted, it should be set down in tabular form according to sales territories or salesmen (Figure 3). It can be further sub-divided by months, allotting a portion of the projected total sales to each month of the year, basing the estimate on the performance during preceding periods. The allottment to each month will follow the seasonal cycle of sales. Each salesman will receive a copy of the final quotas for his area or territory which are based originally upon the estimate which he turned in. During the period, weekly or even daily reports are turned in by the field representatives indicating their performance. It is not sufficient to issue progress charts to the salesmen, showing their performance compared with the budgeted figures. Rather, analysis reports should be made covering all variances, pointing out to the sales personnel where the weakness lies, and giving instructions as to the best way to overcome the deficiency. It is of the utmost importance that the estimated sales budget be met, for all the activities of the company are keyed to its realization; costs and expenses will otherwise be distorted.

SALES BUDGET

After the sales budget has been completed, it is possible to compile the other budgets. Some accounting authors prefer to follow the order of the accounts as they appear in the income statement (for example Finney); whereas others develop the selling expense budget immediately after the sales budget. Either method can be defended logically.

The selling or distribution expense budget is based on the

Figure 4. Forecast of Selling Expenses

Product A

	Expense
Salaries - supervisors	$ 500
Salaries - salesmen	1100
Salaries - clerical	150
Commissions	200
Traveling Expense	300
Advertising	575
Delivery expense	400
Total	$3225

Opposite Page 16

actuals figures of the previous periods, adjusted for expected changes to occur in the year under study, with non-recurring items in past periods omitted from the new estimate (Figure 4). Unless the company is a going concern with the data already classified as to product, territory, and variable or fixed items, it will be necessary first to break the selling expense down by product and territory, allocating to each a portion of the total. Where past records are available, the problem of estimating the amount of expense to be applied to each product is made easier by analyzing past records. The next step is to break the expense down into fixed and variable items, with the variable expenses based on the expected volume of sales. Since there is usually some variation small or great between the expected and the actual sales performance, the variable items must be broken down into expenses at varying levels of sales. This treatment of the variable expense is explained in detail in the next chapter. General Motors in the statistical department in Detroit studies the variable expenses at different levels of volume of business; however through the Index Volume figure that is issued to each division, the necessity of each division making a study of variable expenses at different levels of production is obviated. Each plant is expected to operate at the Index Volume, and therefore the expenses fall into line at that level. Finally the budget will be broken down by months, following the pattern of volume set up for the sales budget. The final budget figures are then tabulated and copies issued to those officers responsible for each expense account. They issue reports of their performance, and the central office in turn compares the actual

SELLING EXPENSE

Figure 5. Production Budget

Product A

Estimate of units to be sold	430	units
Ending inventory	70	
Total	500	units
Less beginning inventory	50	
Production for the period	450	units

Figure 6. Materials Budget

Part X, Product A

Required for production	450	units
Ending inventory	100	
Total	550	units
Less beginning inventory	50	
Purchases budget	500	units
at $15. each	$7500	value

Opposite Page 17

with the budgeted figures, analyzes the variances, and issues a statement to the officers indicating where the budget has been exceeded and advising methods of keeping the accounts in line.

The Production Budget (Figure 5) is based on the expected unit sales, which figure is developed from the Sales Budget (Figure 3). In breaking down the figures into months, the objective is to level the rate of production over the seasonal cycle so that there will be a minimum of labor turnover, thus increasing the efficiency of the workers, lessening the need for training new help, reducing labor and personnel costs. Standardization of product with a view to reducing production costs through simpler methods of processing is important if costs are to be reduced to a minimum. Finally the budgeted production must be adjusted for such factors as losses due to scrapping and obsolescence.

From the completed production budget figures can be drawn the requirements for machinery and equipment for the coming year, the amount of materials to be purchased to sustain production and the labor cost for the period under study. The units of production may, for those departments which are completely mechanized, be expressed in machine-hours, and the required addition to present capacity computed. In departments where hand labor is used, the productive capacity will be based on data derived from past experience, and from these figures the required addition to personnel can be computed. The logical development of every budget is evident, for each one dovetails into the preceding one, all going back eventually to the sales forecast.

Figure 7. Direct Labor Budget

Product A

Department	Quantity	Hourly rate	Cost
Machining	450	$1.30	$585
Grinding	450	1.40	630
Lapping	450	1.30	585
Assembling	450	1.10	495
Total	450	$5.10	$2295

Opposite Page 18

The Materials Budget stems from the required unit production for the forecasted sales. In Figure 6, allowance is made for inventories of sufficient size to maintain production in the event of material shortages, while at the same time it must be kept in mind that excessive inventories reduce profits by increasing idle capital. The best method of control maintains inventories at a minimum safe level, synchronizing purchasing with the fluctuations in production and sales, keeping work in process and finished goods available or near completion so that customer demand can be quickly filled.

MATERIALS BUDGET

The Productive or Direct Labor Budget (Figure 7) is based on the quantity derived from the Production Budget multiplied by the labor rates in the departments, as shown in the illustration. The hourly rate figure may be a standard figure derived according to the method used at New Departure and explained in Chapter 4, Part II, under the heading Standard Labor, and again under Index Volume, a figure that is adjusted for any allowances which past experience has shown will occur between budgeted and standard figures at the given level of operations. The labor budget enables the personnel department to ascertain in advance the number of new hires that will be necessary to meet the program of operations for the coming period. The budget may be expressed further in terms of the number of workers required in each department to produce the quantity of units. The variance between the budgeted number of workers and their output and the actual figures may be analyzed to indicate worker inefficiency and failure of supervision.

Figure 8. Manufacturing Expense Budget

Product A

	Expense
Indirect Labor	$1500.
Supplies	800.
Heat, Power, Light	500.
Depreciation	1000.
Insurance	600.
Office Expense	600.
Total	$5000.

Figure 9. Administrative Expense Budget

Product A

Salaries - supervision	$ 700.
Salaries - clerical	400.
Bad Debts	100.
Supplies	150.
Total	$1500.

Opposite Page 19

MANUFACTURING EXPENSE

Those items which fall under the Manufacturing Expense Budget are generally divided into variable and fixed items, and, in cases where necessary, into semi-variable expenses (Figure 8). The development of the variable expense for different levels of operation is given in the next chapter of this part. A study of prior years records adjusted for any changes in the period under study will yield estimates of the fixed and variable manufacturing expense. Additions to the fixed plant and equipment budget will cause changes in the amounts chargeable to depreciation, taxes, and insurance expense. Heat, power and light are affected by the level of production. The Cost Department, having data readily available, is the logical department for originating the estimated budget; however it is becoming common practice to call in the heads of the productive departments and any service departments affected for consultation before the final figures are released. Other officials who may take part in preparing the final estimates are the controller and the treasurer.

Certain of the manufacturing expenses may be incurred in the coming period, but paid in the following, in which case other columns may be added to the budget estimate indicating the prepaid and accrued items as of the end of the year. Such a breakdown assists in preparing a statement of cash receipts and disbursements as projected for the period under study, and also aid in preparing estimated income statements and balance sheets as of the end of the period.

The final budgeted figures should be spread over the various

Figure 10. Computation of the Value

of

Finished Goods Inventory

Raw Material at beginning	$ 750
Add: Purchases	7500
	8250
Less: Raw Materials at end	1500
	6750
Direct Labor	2295
Overhead	5000
Total	14045
Units produced	450
Unit cost (14045/450)	$ 31.21
Units in Finished Goods at end	70
Value of Finished Goods Inventory	$2184.70

Source: Adapted from Finney, H. A., Principles of Accounting - Advanced, Third Edition, Prentice-Hall, Inc., New York, 1947. Page 481.

Opposite Page 20

departments, charging them directly for expenses incurred therein and adding on a portion of the indirect expense prorated according to some equitable basis, heat on the basis of area, power according to total horsepower of the machines used, machine hours and man hours for other indirect expenses. All expenses must eventually find their way into the cost of the products.

OTHER BUDGETS

Other budgets are made up to cover the estimated administrative expense (Figure 9), changes in the capital accounts such as new issues of stock, and changes in the bond account. Where there is an extensive advertising campaign, a budget may be drawn up showing the monthly charge of the annual advertising expense synchronizing it with fluctuations in the volume of sales. The entire operational picture of the concern will be set down in the form of estimates as to the period under study, broken down by departments (or territories in the case of sales budget), and by months.

The resulting figures may now be carried over to an estimated profit and loss statement as of the end of the period, and an analysis made of the figures. Before the income statement can be made up, the cost of goods sold must be computed. Up to this point the following information is available:

1. Forecast of sales in units and dollars.
2. Forecast of Selling Expenses.
3. Estimated production in units.
4. Raw Materials Budget.

Figure 11. Estimated Cost of Goods Sold

Product A

Finished Goods Inventory at beginning		$2000
Raw Materials Inventory at beginning	$ 750	
Purchases	7500	
	8250	
Less: Raw Materials at end	1500	
	6750	
Add: Direct Labor	2295	
Overhead	5000	
Cost of Goods Manufactured		14045
Total		16045
Less: Finished Goods Inventory at end		2184.70
Cost of Goods Sold		$13860.30

Figure 12. Estimated Statement of Income

Product A

	Amount	Percent
Sales	$21500	100.00
Cost of Sales	13860.30	64.35
Gross Margin	7639.70	35.54
Selling Expense	3225.00	15.35
	4414.70	
Administrative Expense	1500.00	06.86
Net Profit	2914.70	13.44

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5. Direct Labor Budget.

6. Manufacturing Expense Budget.

7. Administrative Expense Budget.

The Finished Goods Inventory at the beginning is carried over from the actual figures in the closing statements of the preceding period. There is no beginning or ending Work in Process Inventory. The only figure lacking is the Finished Inventory at the end (estimated) to complete the estimated Cost of Goods Sold Statement (Figure 10). The computation of Cost of Goods Sold is illustrated in Figure 11.

With the above data on hand, it is now possible to make up the estimated Income Statement for the period (Figure 12). The sales figure is taken from the forecast of sales budget, net after allowances have been made for any returns or credits to customers. Cost of sales, selling expense, and administrative expense are carried over from the respective budgets to the income statement, and the estimated net profit for the period is obtained. Analysis of the figures includes a comparison of the current estimated statement with the statements for prior years, and a comparison of the ratios. Further analysis may be made by setting up an estimated balance sheet as of the end of the period, and working out the ratios of the current period under study compared with preceding periods regarding working capital, acid test ratio, sales to fixed assets, net worth to fixed assets, net worth to liabilities.

INCOME STATEMENT

The general budget has been developed from the first market

survey through the various supplementary budgets and estimates to the completed Estimated Income Statement for the period. The purpose of the estimated budgets is to provide a yardstick to which the actual performance of the company from month to month, week to week, and even day to day can be compared, and a judgment made as to whether the progress is favorable or unfavorable. The budgets themselves are not sufficient, however, to control operations; rather there must be a liaison between the central offices and those in the field or in the productive departments who are incurring the costs and expenses, or meeting the sales quotas. As C. E. Knoeppel says[1], the proper attitude to create is to make each manager, supervisor, or foreman feel that he is a businessman in his own right, running his own business, creating profits and incurring expenses on himself personally. Rowland and Harr[2] in their text give an excellent diagram, setting norms for all responsible officials to follow through budgets which control every activity of the business. Reports of progress flow into the central offices where they are compiled and compared with the budgeted figures to date. Variances are analyzed and progress reports then eminate from the central offices back to the sales representatives or departmental foremen, advising them where the weakness lies, and instructing them how to correct the deficiency. This is the essence of budgetary control, the subject to be treated in the second part of this thesis.

1. Knoeppel, C.E., "How to Make Cost Accounting Effective", Bulletin, National Association of Cost Accountants, Volume VIII, No. 23, August 1, 1927. Page 1067.

2. Rowland, Floyd H., and William H. Harr, Budgeting for Management Control, New York and London, Harper and Bros., 1945. Page 154.

Chapter 3. The Variable Budget

INTRODUCTION

The construction of the general budget described in the preceding chapter assumes that the volume of operations and therefore the amount of expense will be the same as estimated at the beginning of the period. This is the fixed form of budget, and is useful in small organizations where the activity is somewhat limited, and the scope of operations can be rather sharply delineated. However in the larger companies such a budget is found to be inadequate since there is almost certain to be a variation from the expected level of activity. Public bodies such as municipal and state governments may be able to use the fixed budget since their allotment of money for operations is fixed, and therefore it follows that they must limit their use of the cash. It becomes, therefore, a problem for large organizations to consider this aspect of variability in level of operations with a consequent change in the amount of certain expenses which depend on volume for their size.

100 PERCENT EXPENSE LEVEL

In starting a study of the control of variable expense, a decision must be made as to what will be considered the 100 percent level of expense, the level of expense at the productive capacity of the company. Rowland and Harr[1] give several

1. Rowland, Floyd H., and William H. Harr, Budgeting for Management Control, New York and London, Harper and Bros., 1945. Pages 188-189.

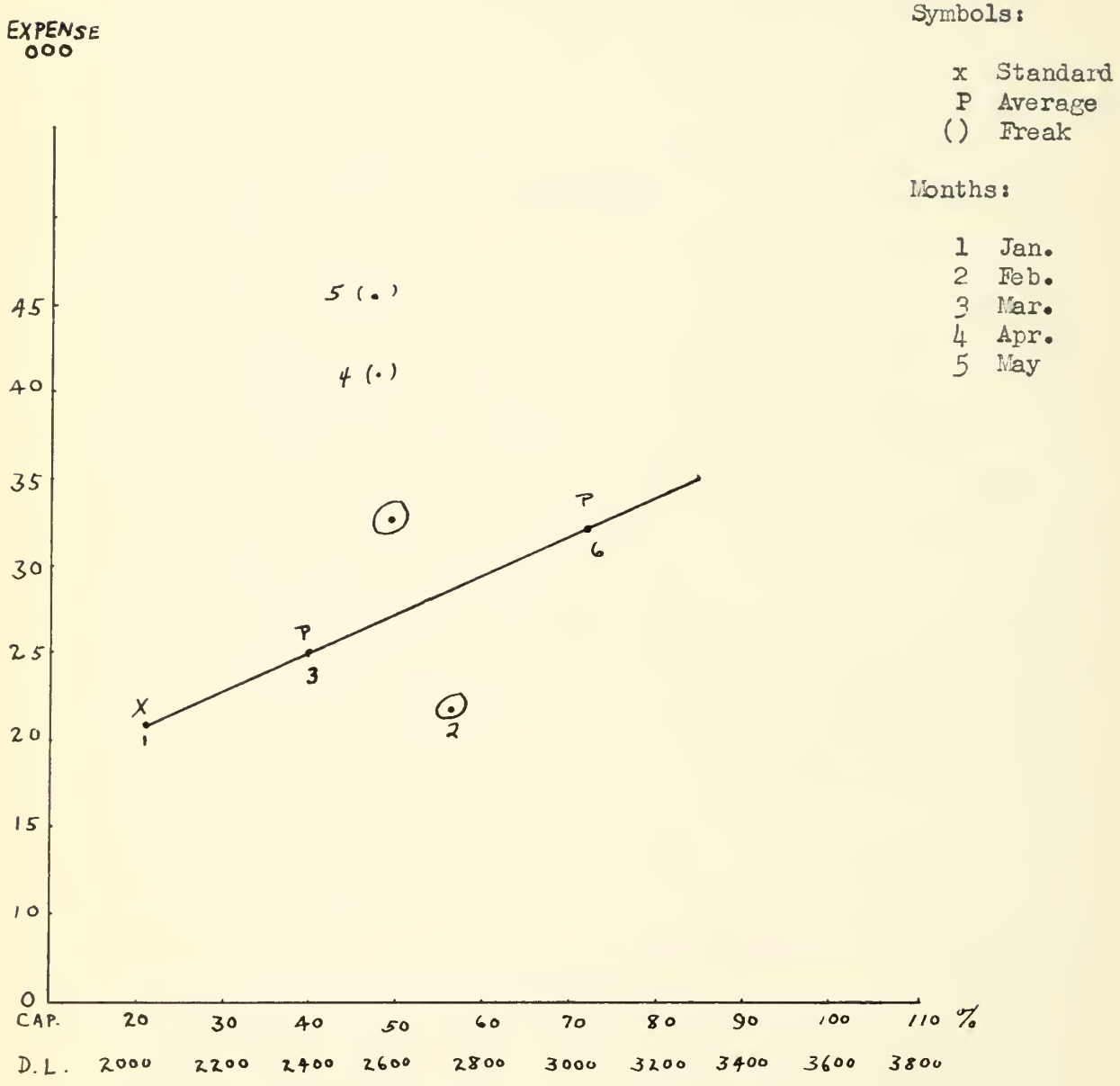
methods of establishing the 100 percent level. The Most Favorable Expense Level is identical with the ideal productive capacity of the plant. Such a basis would be used for setting up the standard cost system, predicating only the most favorable prices for labor, material, and overhead. Such ideal conditions rarely continue for any length of time, and result in over or under absorption of variable expense to an excessive degree. The budget should be based on the expected performance rather than the ideal performance. It is a measure of the maximum limit, the ceiling for expense, whereas standards are the measure of the minimum. Therefore such a basis is unsuitable for the variable expense budget.

The Anticipated Normal Expense Level is not an adequate basis for in this case the 100 percent level of expense is assumed to be the same throughout the entire year. This is often unrealistic since there may be a seasonal cycle to contend with.

If the Sales Quota Level is used, it would necessitate that a new basis be adopted with each new budget period.

If the Break Even Level is accepted as the 100 Percent Level for expenses, it would indicate little reliance on the budget planned. If a company is to make a profit, the break even point must be exceeded resulting necessarily in over absorption of expense; if the point is not attained, then the plant operates at a loss.

Table IV. Scatter Diagram



Source: Rowland, Floyd H., and William H. Harr, Budgeting for Management Control, New York and London, Harper and Bros., 1945. Page 204. Adapted.

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Rowland and Harr therefore propose as the most ideal basis for 100 percent level of expense what they would call the "Company Objective Level", which is based on several factors:

The kind of business conducted,

Product lines handled,

Volume set as the objective,

Facilities needed for this volume,

Organization required.

The normal expense level is based on a rate of operation which will not necessarily be attained at first, but will be reached as the company gains its goal. Consequently it is not necessary to revise these budget standards as the operating rate changes.

There are several good points about this last method which can be noted. The most favorable unit cost figures are obtained, because they are realistic, not idealistic; predicated upon a long-range plan to which the level of operations is keyed. Frequent revision is not required as in other plans involving a short range outlook. Such a long range basis controls all facilities and any variation in them.

After determining the 100 percent level of production and expense, the next step is to determine what the variable expense will amount to at the various productive levels. Small concerns can and do use the estimate basis, which is dependent upon the ability and past experience of the executive. However, the use of the Scatter Diagram (Table IV) has been found to be more accurate. The expense amount is

Table V. Variable Budget Table - Production Department

Dept._____

Account	Activity % 20	30	40	50	60	70	80	90	100	110	120
Indir. Labor											
Heat, Light											
Power											
Rent											
Depreciation											
Total Direct Expense											
Basis of Measure:											
Direct Labor Hours											

Note: The variable expenses are listed by accounts and the budgeted expense at the varying levels of production is carried out to the right.

Source: Rowland, Floyd H., and William H. Harr, Budgeting for Management Control, New York and London, Harper and Bros., 1945. Page 207. Adapted.

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broken down along the vertical axis, and the plant percent along the horizontal. The Basis of Measurement is tied in with the percent to plant capacity along the same axis. The monthly total expense is then plotted on the diagram, using as many months as is practical (at least twelve months). The seasonal fluctuation in the plant production will provide the normal spread. Those dots that fall some distance to one side will be eliminated as freak. The average distance between the circled marginal dots will be denoted by a "P". Dots which coincide with the standard expense at that level will be marked with an "X". A trend line can then be drawn showing the expected expense at the various levels of production from 20% to 100%, connecting the average points. In the case of semi-variable expenses, the expense curve will progress steadily up or down, but at certain levels of production, the curve will ascend or drop vertically. In such cases, it may be possible to have two expense levels along the same line of production. The high figure is used when production is decreasing, and the low figure when production is increasing. There will be cases where the average point will not coincide with the trend line, in which case the latter is used.

Each expense may be diagrammed in the above manner by departments, and then combined in a Variable Budget Table for the whole plant in the form shown in Table V. Such a table affords a way of instantly seeing what the expense should be for any level of production, without having recourse to vague estimates as to what the expense should be.

A more complex Variable Expense Table has been devised by the

Table VI. Departmental List of Percent Variability

On All Expense

Increase	Departments 1	2	3
30% and up	0.375	0.540	0.242
25 to 30%	.380	.542	.243
20 25	.395	.545	.242
15 20	.405	.550	.240
10 15	.415	.555	.240
5 10	.405	.559	.245
0 5	.400	.550	.250
Decrease			
0 to 5	.400	.550	.250
5 10	.380	.535	.242
10 15	.370	.525	.234
15 20	.362	.520	.227
20 25	.355	.517	.222
25 30	.350	.515	.218
30 and up	.345	.513	.215

Source: Alford, L. P., (Editor), Cost and Production Handbook, New York, The Ronald Press Company, 1934, Fourth Printing. Page 125.

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Controller of the Belden Manufacturing Company, and outlined in the Cost and Production Handbook (See Table VI). Each foreman makes an estimate regarding the expenses under his control, based on the production at 100% capacity, allowing for idleness and repair. The accounting department adds on the general overhead items and prorates the whole over the various levels of production. In conference with the foremen, changes are made in the index figures listed on the right of the table if necessary due to changes in the expense items. The index figure indicates the variation in the expense from normal due to changes in the level of production. Thus if production is 20% below capacity, then 0.362 X Expense at 100% level of production - e.g. $20,000, would give the budgeted expense at minus 20% capacity.

WANNER'S SYSTEM

In Table VII, the system is developed completely. In Department #1, the budgeted Direct Labor at 100% capacity is $8450. The actual Direct Labor cost is $6929.20, or 82% capacity. Under Manufacturing Expense, the percent of variation to budget is the 18% variation in productive labor multiplied by the index figure for that minus level of production as indicated in the preceding table, in this case 0.362. The corrected budget figure is $20,000 X -6.52%, the actual manufacturing expense is $18498.22, and the percent of actual to corrected budget is 98.94%, the rate of efficiency.

This method seems to give a more delicate control of the variation in the expense at differing levels of production. However, the

Table VII. Corrected Budget Computations

	PRODUCTIVE LABOR					MANUFACTURING EXPENSE		
Dept.	Budget $	Actual $	% Actual to Budget	100% Budget $	% Variation To Budget	Budget Corrected $	Actual Mfg. Exp. $	% Actual to Corr. Budget
1	8450	6929.20	82.00	20,000	-6.52	18696.00	18498.22	98.94
2	6233	6388.25	102.50	16,450	1.38	16767.01	17256.80	102.92
3	9880	7060.38	71.35	13,880	-6.25	13012.40	14122.77	108.53
Total	24563	20377.83	82.96	50,330	-3.68	48475.41	49877.79	102.89

Source: Wanner, Arthur L., "Corrected Budget Figures", Factory and Industrial Management, Volume 76, No. 1, Page 56.

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use of an index figure makes the variable expense table more complex, adding one more step to the process of seriving the amount of variable expense at a given level of production, and so providing one additional point where clerical errors are possible, without justifying sufficiently its inclusion in a system for deriving the variable expense.

Once the variable expense has been determined for all accounts and for all departments, it is then a matter of control in which the method is the same as that used for any other expense or cost. Part II describes the system in use at New Departure. The foreman receives a weekly report giving the budgeted figures, the actual performance, and the variance. More advanced ideas on the subject of variable cost control propose that all performance reports be submitted in terms that the foreman can understand. Rather than using dollars of expense, the quantity should be presented in terms of number of people employed for indirect labor expense. Power can be broken down into the number of machines in the department.

It has been the purpose of this Part to present a method whereby it is possible to have absolute control over all the activities of a business. It is not sufficient that the accountant have historical facts regarding the operation of the business. Today with conditions changing overnight, it is important that data be received and analyzed in time to put into effect corrective measures to counteract unfavorable trends, before it is too late. This is the essence of fingertip control, the concept presented in the introductory chapter. The system employed at New Departure is so delicate, that excessive expenditures can be detected the following day on the Plant Report submitted to the Controller. Thus

corrective measures can be taken immediately.

PART II

BUDGETARY CONTROL AS

EMPLOYED AT

NEW DEPARTURE DIVISION OF GENERAL MOTORS

MERIDEN, CONN.

PLANT "D"

PART II

Chapter 4. Basic Considerations

INTRODUCTION

It is not enough simply to enunciate some principles and then leave it up to the reader to apply them; but rather the picture is complete only after those same principles have been applied to a case in point, and their practical operation delineated. Application, then, of the principles set forth in Part I will be the primary purpose of this section. In the case at issue we have an excellent example of how sensitive to change a control system can really be; so sensitive in fact that variations in expenses in excess of the maximum limits set up by the budgetary committee will be indicated on the following day's report and immediate steps taken to correct it if the variance is unfavorable. For example, there was the condition in the fall of 1947 when the plant was operating on Saturdays. It was noted, however, that during the week certain overhead expenses were continuing at an excessive level, and when the trouble was traced back to its roots through an analysis of data presented, it was found that the chief trouble was due to idle time on the part of the operators. Obviously the production schedule for the week included too many days, and therefore a decision was taken to cancel any further working-Saturdays until the volume of production would be such as to require it. It is conditions such as this one which are so effectively controlled by the system at present in use at Plant "D".

MATERIAL The terminology employed at Meriden, is generally in conformance

with accepted accounting practice, both in the terms used and in their connotation. However, for the sake of accuracy and completeness, it would be just as well to review some of the more frequently used ones, so that their meaning will not be in doubt. Material, Labor and Overhead are the basic costs. Material costs are handled at the Bristol Plant, for there the Purchasing Department is located. At Meriden a small branch of the Bristol Purchasing Department is set up for the purpose of making small, necessary, and perhaps emergency purchases of supplies. Any item which is going to cost more than a maximum limit set by the department must first be submitted to Bristol for authorization. One of the duties of the Budget Department is to handle the expense analysis of these small transactions, and report the data to Bristol. Purchases of all raw materials, such as steel from the mills for forgings, tube, and bar stock[1], are handled through Bristol and inventories are kept there of all the raw materials on hand throughout the division. Transfers of forgings, bar, and tube stock to the Meriden Plant are handled by a charge to the Meriden inventory account and a credit to the Bristol inventory.

ACTUAL LABOR

Direct Labor is known at the Plant as Productive Labor, as opposed to indirect labor which is called Non-Productive Labor. In the customary fashion for those concerns which operate on standard cost, two sets of labor figures are derived, Actual and Standard. The actuals are picked up from the time-tickets made out by the timekeepers

1. See Appen. A, Chapter 7 and 8.

in the individual departments throughout the plant, and submitted daily to the Cost Department by 8 A.M. These tickets contain the department to be charged, the department issuing the ticket, size, operation, spec, quantity[1], and actual time required, and finally the operator's number. The Cost Department takes these tickets that the timekeepers have sorted by operator's numbers, and checks the total hours indicated for each operator against the payroll clockbook. This serves as a factor of internal control, reducing the chance of error in reading the clockcards, thus eliminating any over or under payment of the payroll. During the check against the clockbook, the payroll rate of each employee is noted on each ticket in the space provided. Then after the tickets are completely checked against the book as to hours and man-number, the rates are extended by the fraction of time worked on each ticket. When added up the tickets represent the total number of actual hours worked and the direct labor actual cost for the entire plant. This included with the indirect labor and other salaried help serves as a double check with the payroll department each pay period. Daily the tickets are sorted by departments, productive operations and expenses, and posted to the Hourly Payroll Distribution, which data is turned over to the Budget Department for use in their reports, (Chapter 5). Several times a week those tickets with quantities are posted to the Work in Process Inventory cards.

1. Although every operator reports his production on his job cards for every operation, the timekeeper reports on his time tickets only the quantity for the final operation in each department, so that quantities will not be reported more than once in each department and charged to work in process. The job cards are retained in each department for efficiency analysis purposes (Chapter 5).

Standard Labor Cost is developed in the accepted way, through time study and a consideration of other factors to be further discussed under the heading of INDEX VOLUME in this chapter. Standard Labor Cost is expressed as so many hours per thousand bearings and broken down by departments and by sizes. By multiplying standard hours per thousand bearings by the average hourly rate of the department, the Standard Direct Labor Cost per thousand bearings of any size is obtained - what is called Standard at Standard at the Plant.

STANDARD LABOR

The Production Reports, submitted to the Cost Department along with the time-tickets, show the production by operation, size, department, and specification where necessary[1]. The Cost Department extends the quantities by the Standard Direct Labor Cost per thousand units to get the Standard Cost of Direct Labor for the actual amount of work produced - Standard at Actual. The difference between this last figure and the actual labor cost as presented by the time-tickets is known as the labor variance.

The Variable Expense is any expense which changes with the level of production; it is considered to be the remainder after fixed expense is subtracted from the total factory burden. Although from the theoretical point of view, there may be a distortion at the extremes of high and low production, as a rule it is considered that

VARIABLE EXPENSE

1. Perfex and Ultra-Perfex Specifications and certain other specs which are being studied by the Cost or Standards Departments are reported separately by operation, time, and quantity throughout.

productive labor and variable expense are in the same relationship at any volume level. Although some concerns provide a further division into variable and semi-variable expenses, it has not been the practice at New departure to segregate the two classes, but to consider all Burden that is not Fixed, as Variable. The ratio of productive labor to total variable expense by plant and department is expressed, as usual, in percent. (See Chapter 5 under the heading CHART OF ACCOUNTS for a discussion of the several burden centers and their variability or non-variability)

FIXED EXPENSE

A Fixed Expense is any expense which by its nature does not vary with the volume of production. At New Departure the basis of a non-varying expense is the expense necessary to maintain the Plant in the event of a six-month shutdown. Some accounts are mixed, being a percentage fixed and a percentage variable. Account 110, Supervision, is about 60% fixed. On the other hand, Account 800, Depreciation, rentals, Taxes, is 100% fixed.

Before turning to a consideration of Index Volume, there are one or two other concepts to be mentioned. Actual Variable Rates are the actual variable expense divided by the actual productive labor. The Standard Variable Rates are the budgeted variable expense divided by the standard productive labor. These rates will be used in making up the reports daily and weekly showing the plant performance against the standard, and indicating the efficiency of operation. The variable expenses should, of course, be adjusted before the rates are set up. All rates for main and sub accounts should check to the total plant rate.

Standard Overhead or Burden Rates for the entire budget are composed of the budgeted variable expense plus fixed expense divided by the budgeted productive labor at standard or index volume as used in standard bearing costs.

INDEX VOLUME

The Standard or Index Volume is the cornerstone for the entire plant budget, upon which depends every item that goes to make up the budget program. The Index Volume is compiled by the statistics department in Detroit, based on a careful study of economic conditions, future as well as present trends in business, the future prospects of the automobile industry; a study also of General Motors' position in the automobile industry, the future economic condition of the various members of the working class who buy the automobiles in the various price ranges, what their purchasing power will be in the future, what volume of production will meet the demand. Under present day conditions, where the volume of demand is so great, due to the great scarcity built up over the war years, the traditional methods of analysis of the market have been foregone, and a new Index Volume based mainly upon the previous year's performance has been accepted. There is some indication however that attempts will be made to return to the more accurate methods used in former years of analyzing the market, in order to arrive at the Index Volume that will be set for the Corporation. A present-day automobile manufacturer such as General Motors is a closely knit group of semi-autonomous divisions, each one specializing in some part or subassembly or finished product that goes to make up another item of merchandise sold by the Corporation, or is in itself a consumer good.

Some of the products manufactured by General Motors are sold to its competitors for use in their autos. Ford and Packard buy bearings from New Departure. This closely knit organization must be carefully synchronized throughout its parts so that any one factory does not get out of line and over-produce, or create artificial shortages within the company through under-production. In order to keep the many separate divisions and factories operating at a volume level that will supply the necessary parts, sub-assemblies, and assemblies in the quantity and at the time needed without piling up excessive inventories, a system of central control has been devised over the volume level for all the component parts of the Corporation. Every year the Detroit Office set up the Index Volume for the entire corporation, the amount of production necessary to supply all the finished products that will meet the sales demand for the coming year and still maintain an adequate reserve inventory of finished products and spare parts for replacement and repair. This Index Volume is then broken down over the entire Corporation, each division receiving an Index Volume that will enable it to meet its obligations toward the Corporation in the way of necessary parts and assemblies, and at the same time provide an inventory for taking care of any customers independent of General Motors. Each division then takes the Index and breaks it down over its separate factories so that each produces at a level that will ensure that the division will meet the level set by the Detroit office. The Index as received from Detroit is not in final form, but is rather a tentative figure, subject to revision by the individual divisions, because past experience has shown that many times there are factors present in the various divisions that are not fully

understood in Detroit, and which radically affect the tentative schedule as submitted to the divisions by the Detroit General Management. However, the revised Index Volume must first be submitted to Detroit for final approval before the division can accept it as the foundation for their new budget for the coming year. Once the final figures are accepted, then new budget estimates are compiled, new budgetary standards set up, and new rates derived for the coming year.

DEVELOPING THE PLANT BUDGET

The Index Volume as received from Detroit is expressed in labor hours. Each division uses the final figure as the level of production which it will follow for the coming fiscal year. The use of this device has an added advantage, in that it does away with the necessity for having tables of variable expenses as computed at different levels of production (See Part I Chapter 3). The level of production is now set for the year after considering all possible emergencies that might arise. A change in this computed level necessitating radical revisions in estimated budgets and rates should not be required under most normal circumstances. At New Departure Division, a conference is held at Bristol and the Index Volume is broken down among the various plants in the Division, Bristol, Meriden, Guilford, Sanduskie, according to their past participation in the total production of the Division. When Meriden receives its allotted portion of the figure, the Plant's Index Volume is further broken down by departments according to their past record of performance. These figures give the volume of production for each department expressed in labor/hours. By multiplying this figure

by the average hourly rate of the department, the Index Volume is now expressed in money (See the section of this chapter under STANDARD LABOR).

Normally, the Variable Budget is compiled once a year, based on eight to twelve months experience of the preceding year. In a general way the budget is compiled in the following manner. The actual expenses of the preceding year are listed, and adjustments made for the non-recurring items, or for items expected to occur for the first time in the coming year. Totals are made of each account, and these are divided by the standard productive labor for one year to get the new rate.

BUILDING UP THE VARIABLE BUDGET

Now let us turn to a more detailed study of how the variable budget is built up. Let us study in particular the budget for the entire plant, and once this system is understood, it is easy to see how the departmental budgets are set up, because exactly the same method is used there. In the first place, the expenses of the preceding year are compiled according to main accounts. Before new rates can be considered, these actual figures must be adjusted. Following are a few points to be considered[1]:

1. Through a study of charts and the data compiled throughout the preceding year, those months which show an inefficient control over expenses will be singled out. Extraordinary or unusual expenses which

1. Roszelle, A. M., The Variable Budget, Page 5. (Adapted from this unpublished paper written by the Controller of Plant "D").

cannot be substantiated in those months will be eliminated from the new expense figures.

2. Any additional expense which did not occur in the preceding period under study, but which will be expected to occur in the new period, is considered.

3. Increases in wages which did not appear in the preceding period will be included in the new budget.

4. Items of insurance, taxes, depreciation, heat, power, and light are adjusted to current operations.

5. Supplies and purchased materials are studied for price changes and adjustments made if necessary.

6. Productive labor is adjusted to current rates and any savings or increased costs are considered and adjusted. Cost per thousand of productive operations as they appear on the cost sheet is comparable to the adjusted productive labor in the new budget.

When the above adjustments have been considered and any changes made where necessary in the main account totals (according to Schedule E, Form B in Appendix C) the new variable rates are developed by dividing the adjusted main account expenses by the adjusted Index Volume. Service departments which do not have productive labor derive their departmental rates from the total productive labor of the plant. Variable rates are thus set up for nineteen departments throughout the plant, eight major accounts (See Schedule D, Form A in Appendix C), and one hundred and twenty-five sub-accounts for each department. Considering the total plant

and departmental rates, approximately 1500 rates are developed for the entire variable budget.

BUILDING UP THE FIXED BUDGET

The Fixed Budget does not present the same complications as does the Variable Budget, for these expenses are fewer in number and are not as susceptible to change as are the variable expenses. The fixed expenses of the preceding period are adjusted for current rates. Additions or subtraction of personnel regarded under the fixed category is made where necessary. The adjusted figures are inserted in Schedule D on line 25 (See Appendix C).

The total plant expense, fixed and variable, adjusted for the new period is divided by the index volume for the plant and departments to get the total standard burden rate, which is used in making up the standard bearing cost sheets for the new period.

ANALYSIS OF BURDEN

There are three principal schedules used during the study of new budget rates for the new period at Plant D - Schedule D, which is the Analysis of Burden for the entire plant; Schedule C, which is the authorized list of plant personnel, giving full name, clock number, official title of job, pay rates or salary received; Schedule E, which lists the adjustments to the Variable Budget. A copy of Schedule C is not included among the papers in the appendix since it is highly confidential and no purpose would be served presenting a fictitious copy. Schedule D and E are presented in the appendix for the reader's study along with the text of this part.

Schedule D is the analysis of the burden for the entire plant, and is used for setting up the new rates for the variable expenses. As will be seen from a study of the schedule presented in the appendix, along the top are the main accounts and their titles, Indirect Labor, Operating Supplies and etc. The accounts are tabulated from Account 100 to 1000. Total manufacturing expense is shown in the next to the last column to the right, and the actual net productive labor (minus any premiums for overtime) is shown in the last column. In this column would be inserted the adjusted index volume broken down by months, but in the year in which this budget was compiled, adjusted actual labor was used as the basis of the new rates due to the abnormalities brought on by the war and labor unrest.

Line 3 to 12 indicates the actual expenses by months for an eight month period. Line 13 provides for subtraction of any overtime premiums where they may be included in the actual figures. Line 14 shows the totals unadjusted. Line 15 subtracts out the fixed expenses at actual (Not Account 800 is 100% fixed, and the other accounts have a percentage taken out). On Line 17 the adjustments compiled on Schedule E are brought on to this analysis, giving the adjusted figures for the new period on line 18.

The rates are now reviewed for the preceding year, and the new ones developed. Line 19 indicates the standard rates for the preceding year, Line 20 shows the actual (the unadjusted actual totals on Line 14 divided by the unadjusted actual labor figure in the last column line 14.) Line 20 is the adjusted actual rates based on the adjusted

totals Line 18 divided by the adjusted productive labor in the last column. Line 22 gives the new rates for the coming period.

On Line 23 is shown the fixed expense for the preceding year adjusted for any items indicated on Schedule E that affects fixed expenses. On Line 25 are shown the proposed fixed expenses for the coming year. Line 26 and 28 are the rates for the year under study and the revised rates for the new period, Line 28. Line 29 is the budgeted expense for the new period using the new rates times the estimated production for the new period. Any savings for the new period over the preceding are shown in black on Line 30, in red if the expenses will be greater than the adjusted actual of Line 18, (Line 29 minus Line 18). Line 31 is the savings on Fixed Expenses for the new period over the preceding, comparing the same period of time used for the actual Line 3 to 12. This will be Line 15 adjusted for any items listed on Schedule E, item #1, minus Line 25 expressed in the same period as Line 15. Line 32 will be the total variable and non-variable savings for the new period over the preceding.

ANALYSIS OF ADJUSTMENTS

Schedule E shows the adjustments proposed for the new period over the old. The totals along the bottom of the chart are carried over to Schedule D and entered on Line 17 as adjustments to the period under study. Account 800 is omitted since this chart shows only the variable expense adjustments. Where items indicate an increase they are in black, and where they are a decrease

over the preceding period they are shown in red. Transfers from one expense main account to another are debited and credited in black and red respectively, see Item #5. Changes in the Productive Labor are shown in the last column to the right Item #2.

BURDEN ESTIMATE

Schedule F (Appendix C) is the Burden Estimate. The new rates developed in Schedule D are carried over to this schedule. The purpose is to bring all manufacturing expenses into the productive departments so that ultimately all costs will be prorated into the cost of manufacturing the bearings. Each department bears its share of the non-productive expense. After the total plant assessments are computed, they are broken down by departments. Each department burden is then further broken down on the Schedule F by accounts and rates to absorb the entire assessment to the department. All departments combined will then absorb the entire plant burden.

After considering these various basic concepts concerning the budgetary system of control at the Meriden Plant, we are now ready to set the wheels in motion and observe the actual working out of these same methods in the Plant.

Chapter 5. Budgetary Control in Operation

Before plunging into the detail of the operation of the system in Plant "D", it might be well first to catch up a few loose strings and DATA SOURCE set the stage, as it were, for the scene to unfold. As a sort of review, then, thereader might turn to Chapter 4 of this Part, under the heading ACTUAL LABOR and STANDARD LABOR, which tells how the tickets and production reports originate and what is done with them. Each operator on a productive job has a yellow card with the name, operator number and department. Subject to further check by the job-foreman, each operator keeps track of the operation, job number, size, spec, number of pieces done, time started and finished. Any time off for rest is also noted to be charged to the proper account by the timekeeper. The timekeeper also makes out tickets for the non-productive help in the department, periodically collects the yellow cards from the operators and makes out the necessary productive time tickets. The yellow cards are retained in the department office and efficiency is figured out for each operator daily, and percentage to 100% production is recorded based on eight hours. The yellow cards are kept for six weeks as reference both for the cost department, and for any possible further efficiency study. The time tickets are submitted to the cost department where the data is posted to the Hourly Payroll Distribution, and then turned over to the budget department for their Actual Labor figures on the budget reports. The timekeeper also makes out a production report by departments with

the data outlined on Page 34 of Chapter 4, and this is submitted daily to the Cost Department where a distribution is made up similar to that used for the time tickets. This data is then also turned over to the Budget Department to be used as the basis for their standard labor figures.

The monthly fixed expense is divided by the number of working days in the month to get the daily charge to fixed expense, standard. OVERHEAD Actual figures are prepared from data collected daily, or from figures that must be prorated off of weekly or monthly reports. The Standard Productive Labor for the day multiplied by the variable rate for each main account gives the standard variable expense for the day. The actual figures are determined in the same way as the fixed expense, either from daily reports, or prorated from weekly or monthly. The fixed expense added to the variable gives the total expense.

The Principle Reports which will be considered in connection with the system in use at Plant "D" will be: (Consult Appendix C)

Form D - Daily Plant Report Worksheet

Form E - Daily Plant Report

Form F - Budget Performance Worksheet

Form G - Budget Performance Report (Foremen's Statement)

Form H - Weekly Labor Report

The Daily Plant Report Worksheet is compiled each morning by one of the clerks in the Budget Department. Charges to the various

accounts along the top of the form are made from data submitted by the

DAILY PLANT REPORT WORKSHEET

Hourly Payroll Distribution, and from other reports which may originate where the expense was incurred. Certain charges originate directly within the departments and will be reported by the timekeeper on pink tickets (indirect charges for labor to various sub-accounts of main account 100). Charges for scrap losses will originate on the scrap report; power expense is prorated daily and by departments according to a breakdown prepared by the engineering department; certain special salary accounts originate in Plant "A"; other miscellaneous expenses are put in a special accounts payable section. The charges are listed by account and by department.

The standard productive labor for the day is received from a distribution similar to the Hourly Payroll Distribution. The clerk has a chart with the rates by accounts and by departments. Multiplying the standard productive labor by the rates, by accounts and department, gives the standard variable expense. Fixed charges are added in to obtain the total standard expense. These totals for actuals and standards are brought over to the Daily Plant Report (Form E).

On the Daily Plant Report, the total actual burden is the total of the expenses on the upper half of the Worksheet. Fixed charges are

DAILY PLANT REPORT

deducted in the next column to show net actual variable burden in the third column for the day. The standard variable burden is brought over from the totals at the bottom of the

Worksheet, and the Savings are shown in the column so headed (black if the actual is less than the standard, and red if the standard is less than the actual). The Savings for the month to date are shown in the next section broken down by main account. The last two columns on the right are a memo showing for comparison purposes the actual variable rate or the actual expense to date divided by the actual productive labor, and the standard variable rate which is derived on Schedule D Line 22. The lower section of the Report is a recap of the upper with further figures for comparison. The Actual Productive Labor for the day, month to date, and year to date are given, and the same data for the Standard Productive Labor. The Saving for Labor and Burden is also shown and the Total Saving in the last line. As a memo, the premiums for overtime and night shift are also shown.

The Daily Plant Report is completed and on the desk of the Resident Comptroller (Mr. Roszelle) daily at noon showing the Plant performance for the previous day from midnight to midnight[1]. A copy of this report is also submitted to Plant "A" and formerly was sent daily to Detroit. At the present time, Plant "A" is sending a Division Report to Detroit incorporating the performance reports of all the plants in the division. This reduces the number of reports going to Detroit. The Comptroller is most interested in the recap section of

1. According to Mr. Roszelle, during a six year period when Plant "D" was submitting reports to Detroit, the Daily Plant Report was in the hands of the executives in Detroit every day without fail at 2 P.M.

the Report, because here any abnormalities show up immediately. As soon as actual productive labor or actual variable expense gets out of line the least bit, the abnormality shows up in red in the column for the daily saving in Labor and Burden. The abnormality can be easily traced to the exact expense through the elaborate breakdown of the data into main accounts and sub-accounts with rates by account, department, and Plant. See below the principle departmental expenses by main account and sub-account under the heading CHART OF ACCOUNTS.

FOREMEN'S STATEMENT WORKSHEET

The Foremen's Statement Worksheet is made up on a regular General Motors Form #599, general purpose worksheet. The Budget Department intends to have a special form printed up for the particular purpose of preparing the Foremen's Statement. Where the Daily Plant Report indicates all the expense charges to the main accounts the Foremen's Statement is concerned with a breakdown of account 100, Indirect Labor, and other charges which are directly under the control of the foreman. The Daily Plant Report gives the efficiency for the entire plant, whereas the Foremen's Statement gives the efficiency for the particular department, leaving the responsibility upon the shoulders of the foreman to see that any excessive expenses are brought under control. Conferences between the individual departmental heads and the comptroller set up the estimated changes in any of the burden accounts at the beginning of the new period. During the year, it is the duty of the foreman to see that his performance follows his estimate. The Foremen's Statement then shows the individual departmental head what his performance is in comparison with his estimate.

The Worksheet, Form F, is prepared in the same way as the Daily Plant Report Worksheet. The Hourly Payroll Distribution submits the actual productive labor in hours and money by department and by operation. These figures are listed in the proper column on the Worksheet which is merely a reproduction of the Budget Performance Report. All actual figures for the sub-accounts under main account 100 are also given. Standard figures are picked up from Standard Labor Distribution, the counterpart of Hourly Payroll Distribution, and multiplied by the variable rate for the different sub-accounts. The standard cost in money and hours for the various productive operations is derived from the production report quantities multiplied by the standard cost per thousand as indicated by the standard cost sheets, showing standard at actual. Variances are then shown, being the difference between the actual and the standard figures.

FOREMEN'S STATEMENT

The Foremen's Statement is a recap of the figures set up on the Worksheet. Where formerly both hours and money were submitted to the various foremen, at the present time only hours are reported. This is in line with the latest cost control theory that all reports should be submitted to the department heads in terms which they can easily understand, and thus be able to see what effect any proposed change would have on the performance figures. A summary of this report is sent to Plant "A", and a recap called the Weekly Labor Report is submitted to the comptroller, Mr. Roszelle. (See Appendix C, Form H).

The Daily Plant Report and the Foremen's Statement are the heart of the expense control system. The comptroller is appraised of the entire plant performance through the Daily Plant Report. The foremen see the performance of their department in respect to those expense accounts under their direct control through the Foremen's Statement. Responsibility is placed at the level nearest to the origin of the expense. The foremen assist in making up the expense budget for their departments at the start of the financial period. The Budget Department appraises them of their performance to date through the Statement in terms which they can easily convert into numbers of personnel in that expense category. Hence they can make exact changes to keep expenses in line. The comptroller sees all the plant expenses at a glance and can trace any excessive expenses down to their source through the various breakdowns and charts made up by the Budget Department. The system's outstanding characteristic is its sensitivity to any change in the expenses.

There are three other controls in use at the Plant which are worth mentioning. They help round out the control picture, and aid the Budget Department in giving particular attention to certain expense items which could easily get out of hand (Order Cost Control, and Current and Forward Program on Tools). The "Four Month Forecast of Productive Labor and Burden" is an estimate of what the plant should do during the coming four months based on the performance for the first week of each month. It is made up in revised form every month, always basing its forecast on the first week of the month. This report is sent to Bristol Plant "A".

The development of the Four Month Forecast is from a purely hypothetical standpoint. If production continues for the four months on the same basis as the first week used as the standard, then the expenses will be as forecast. This type of report transforms accounting from a purely historical and static science, dealing with what has happened and can never be changed now because all has been accomplished and the record is there, to a live and active science dealing with what can be controlled and changed because it has not happened as yet.

FOUR MONTH FORECAST

The Standard Productive Labor of the plant for one day is multiplied by the number of working days in the month (omitting any Saturdays). Add in the estimated labor for the Saturdays to be worked during the month. The Total is the Estimated Productive Labor for the month at standard. Multiply the total Estimated Productive Labor at standard for the month by the total variable rate for the Plant to get the total Variable Expense estimated. Add in the Fixed Expense for the month and the total is the Total Estimated Manufacturing Expense at Standard.

TOTAL ESTIMATED MANUFACTURING EXPENSE AT STANDARD

The next step is to figure the Estimated Actual Manufacturing Expense for the month. The total actual productive labor for one week is figured, plus the total actual burden for the same period (Column 1 of the Daily Plant Report for one week). Subtract the productive labor and burden for Saturday, if worked, along with any Salary charges for Saturday. Divide the remainder by six, and multiply by the number of working

days in the month (omitting Saturdays). Add back in the salary and the estimated Saturday expense, if any. Add in also all Accounts Payable charges (charges from Plant "A" for Material, Equipment, and Supplies transferred to "D"). The total is the estimated manufacturing expense at actual.

The difference between the actual and the standard expense is the variance for the month.

A further study is made of forecasted expenses by showing the Rate of Absorption of Burden based on current rates. This will indicate whether the burden for the forecasted four months is being over or under absorbed. Any marked variance in this column will be watched with much interest. The Estimated Productive Labor at Standard multiplied by the total plant burden rate will give the Absorbed Burden. The Absorbed Burden minus the estimated actual burden for the month gives the over or under absorbed burden.

CURRENT RATE OF ABSORPTION OF BURDEN

This method described above is carried out for four months multiplying the original expenses for one hypothetical day by the number of days in the next month and so forth until the report has been compiled for four months.

New Departure along with other divisions of General Motors constructs many of the machines used around the plant, and performs

ORDER COST CONTROL

other jobs of a construction or mechanical nature through her Construction and Mechanical Department. Orders are labeled as "C" or "D" Orders depending on whether it is a construction or mechanical job. Cost cards with necessary data are kept and maintained even though the actual cost of a job is not figured out as an individual case, but the expense merely carried into the general plant expense. In this way any C or D order can be figured out easily if the necessity arises. The expense of the job is charged to the proper account and the record preserved so that when the department reports time spent on any job around the plant, the proper account can be charged. The cost of building any machines for other plants will be charged to the plant concerned. At the present time much equipment is being built for new plants in the Division. Cost of building these machines will be billed to the proper plant. The importance of this control is to make sure that the many construction, maintenance, and mechanical jobs throughout the plant are always charged to the same account. This is one of the essential and fundamental points in a good control system, that the cost and expense analysis is so set up that there is no possibility of a charge finding its way into two different accounts and thus distorting the true picture of performance. When the Construction and Mechanical Department sends out men to do jobs throughout the plant, the individual department where they are working sends in the labor ticket for their work (except in those cases where the department controls the work performed by its own men throughout the plant). When the cost department receives this ticket, it must be charged to the proper account. The Order Cost Control is a continuous check on expense analysis to see that the proper account is always charged

for the expenses of these jobs.

The Current and Forward Program on Tools controls all expenses connected with the development of new tools and new manufacturing proce-

CURRENT AND FORWARD PROGRAM

dures. In the automobile industry where style is such an important factor each year, and where new inventions and new gadgets are continually appearing on the new models, it is necessary to maintain a special program to control the cost of developing new tools and methods to put these new developments into mass production. Account 11 is charged with all new tools and procedures, additions and new items. Replacements of new tools which have worn out are not charged to this account as they no longer constitute cost of development. Grinding, cutting, and forming tools and dies connected with new developments and styles are too shortlived to be charged to this program.

Regarding the subject of control systems, a final word should be said about the Work in Process Inventory Control. In a plant where

PARTS IN PROCESS CONTROL

the parts in process may run into the millions of units, it is very necessary to make sure that no work is shipped out that does not get credited to the Work in Process Inventory. Therefore between Final Inspection and Finished Stores a partition has been erected with a small opening through which passes a chute. No bearings can get into Finished Stores without passing along this chute and through the opening. A dispatcher's desk is located here and all bearings are recorded as they pass by along the chute. Physical inventory is taken once a year at standard and adjustments are made to the Work in Process through the

standard labor distribution (Production Reports). The 8002 account, Work in Process, is carried at standard throughout, material, labor, and overhead. Raw Material is carried at standard, price variances being handled through the invoices. Finally, finished stores is also carried at standard.

CHART OF ACCOUNTS

The concluding subject to be dealt with in this chapter is a chart of accounts, a list of the principle costs and expenses charged directly to the individual departments. These are the items over which the departmental foreman has direct control, and for which he is responsible. The main accounts are the round numbered accounts, 100, 200, 300, and so forth. The sub-accounts are 110, 120, and so forth.

INDIRECT LABOR - MAIN ACCOUNT 100

Account 110 - Supervision. Plant Manager, Assistant Plant Manager, Superintendents, General Foremen. Assistant General Foremen and Department Heads. This item is about 60% Fixed and Non-varying.

Account 120 - Clerical. Secretaries, Typists, Timekeepers, Payroll, Cost, Production and Departmental Clerks. This expense, while fixed in a few key positions, is highly variable in most instances.

Account 130 - Material Handling. All those engaged in the movement of materials, either within or without the plant, including Truckers, Weighers, Counters, Stock Crib Attendants, and all labor involved in the delivery of supplies to departments,

scrap and chip handling, sorting mixed work. This item is 100% variable.

Account 140 - Building and Property Attendants. Plant Police, Yardmen, Matrons and Janitors. This is a highly variable expense of which a portion is, of necessity, fixed.

Account 151A- Machine, Tool, and die efficiency. Linemen, Set-up men, Toolsetters and Leaders. Likewise, a highly variable expense.

Account 160 - Drafting. Draftsmen. Variable, with the exception of that portion fixed for future development work.

Account 180 - Inspection. All labor involved in Tool Inspection, Floor Salvage, Final, Outlying Machining, Bore, Surface, Cup Ball Race, and Noise Test. This is a 100% variable item, and if it could be properly controlled, would be classed as prodective.

Account 199 - Sundry. Boiler and Power House Workers, Tool Crib Attendants, Doctors, Nurses, Safety Engineers, and all labor involved in instruction and learning, product washing, time and motion study. This is a mixed type of overhead expense, of which a portion is fixed and the balance variable.

SUPPLIES - MAIN ACCOUNT 200

Fuel - Coal, fuel oil, gasoline. A portion of fuel is fixed to maintain proper heating.

Lubricating and cutting oils - Lubrication of machines and tools and compounds. 100% variable.

Processing Supplies - Sandblast sand, slushing oil and grease used in product washing compound, quenching oil, varsol. 100% variable.

Mill Supplies - Towel, soap, waste. Cleaning rags and janitors supplies. 100% variable.

Office Supplies - 100% variable.

TOOLS - MAIN ACCOUNT 300

Short-life cutting tools such as drills, taps, forming dies, and grinding wheels; special tools such as dies, jigs, fixtures and gauges manufactured by New Departure or purchased from outside vendor; permanent tools such as chucks, vises and dial indicators. All items 100% variable.

POWER - MAIN ACCOUNT 400

Beyond a certain fixed minimum charge for which New Departure has contracted with the Power Company, which charge is independent of volume, the power bill is variable.

MAINTENANCE - MAIN ACCOUNT 500

Buildings, grounds, machinery, tools, furniture and fixtures, and plant maintenance and rearrangement. Expenses for maintenance and rearrangement of buildings and grounds are considered fixed, while the balance of those mentioned are regarded as variable.

EMPLOYE, INSURANCE & TAXES - MAIN ACCOUNT 600

Schedule of payments made by the Corporation and charged to the individual department:

Employe Group Insurance (For each employe having $2,000 Life Health & Accident Insurance) ----------$20.28 yr.

State Unemployment Compensation (Based on $2,500 yearly earnings - 1.8%) ---------- 45.00 "

Federal Unemployment Compensation Tax (.3%) -------- 7.50 yr.

Old Age Benefit Tax (1%) ----------25.00 "

Vacation Allowance (2.3%) ----------57.50 "

Total $155.28 yr.

This is the tax and insurance bill for every employe on the departmental payroll. Other items in this account are Employe Compensation and Retirement Plan. It is a highly variable account.

LOSSES - MAIN ACCOUNT 700

Scrap, refinish, lost machine time, waiting for work, waiting for schedule and time allowed. This expense is 100% variable.

DEPRECIATION, RENTALS, TAXES - MAIN ACCOUNT 800

The charge to a department is 10% of the value of each machine on the floor, plus a city tax of the total valuation of all the equipment and parts in process. This account is 100% fixed as long as the machinery remains in the department.

MISCELLANY - MAIN ACCOUNT 900

This account includes experimental expense on product and equipment, traveling, telephone, postage, suggestion plan, welfare and recreation, and inventory expense. All of the above items are variable with the exception of experimental and telephone which are fixed[1].

This brings us to the end of the Chart of Accounts and also

1. Source: Chart of Accounts as presented on pages 2 to 4 of THE VARIABLE BUDGET, by the Plant "D" Comptroller, Mr. A. M. Roszelle.

completed the chapter dealing with the operation of budgetary control. As the reader has seen from this chapter, budgetary control does not stop with a mere tabulation of the costs and expenses, but rather continues on to a control of the same, indicating where the expenses are excessive in comparison with the budgetary standard, and offering the means of correcting the excess before the trouble has progressed very far. Budgetary control at Plant "D" goes even farther than this, projecting a forecast four months into the future, and giving management a preview of what the expense will be over a four month period if production continues at the present level. Other control programs are the Order Cost, Current and Forward Program, and the Work in Process Inventory Control, all of which were treated briefly.

CONCLUSION

Chapter 6. Conclusion

In the preceding pages, it has been the aim of the writer to lay down the broad theoretical foundations vital to the successful operation of a system of budgetary control, to make a few observations of the method of building up a budget which will allow for the utmost control of expenses; and finally to apply this same theoretical structure to the budgetary system as devised and operated at Plant "D", New Departure Division of General Motors, Meriden, Connecticut. The ultimate purpose of any system of budgetary control is the reduction of overhead, costs, and expenses through a more scientific scrutiny of the transactions that give rise to the expenditures before it is time for these costs and expenses to be incurred. The control aspect is especially of interest today when there are such tremendous pressures on all sides for increased costs of operation on the one hand, and for lowered prices to the consumer on the other.

Many of the techniques pointed out in the foregoing chapters cannot be applied overnight in a plant where the control has been haphazard and intermittent. There is a certain very necessary psychology that must be impressed on every member of the organization from the general manager down to the lowliest employee, a realization that any system of control is no better than the responsible members who enforce it to the hilt, observing every law and precept as handed down by management and the accounting department. The control must be constant and continuous, reaching into the very core of the concern, infusing into the veins

of responsible officials a lively spirit and enthusiasm about cost control and cost reduction. The first step must be toward adequate and complete education of the employees and supervisors regarding the control policy. Such education should be handled by the cost department, rather than, as in the experience of some companies, turning the responsibility of training the supervisors and employees over to the foreman of the individual department. Reports on progress must be submitted to the foremen showing actual performance and budgeted performance and variance, indicating the variance in such terms as the foreman can readily understand and translate into labor units, or any other unit with which he is dealing. A report which discloses merely dollars of variance is meaningless to most foremen.

After noting the history and development of the control idea, we have turned to a detailed consideration and building up of a plant budget, starting with the sales budget and showing how many factors both internal and external to the concern are weighed and analyzed before the final sales figure is accepted. From this key figure we are then able to compile the selling expense for the period, volume of production, material budget, labor budget, manufacturing expense budget, administrative expense and other budgets. A more detailed description of the variable budget has been given because this is the most difficult budget to prepare, and is usually the one which causes the most trouble after the budget is in operation.

Part Two applies the theory to Plant "D", giving a detailed

study of the system in use at the plant. The control is remarkable because it is so sensitive to change, indicating at once in the precise spot where the unfavorable trend lies. The Daily Plant Report gives the controller the key figures as to the efficiency of the operations of the preceding day, and is the means whereby he is able to keep his finger on the pulse of the plant, analyzing its activity and noting where the costs are rising above the budgeted limits. If the delinquency is a serious one, steps are taken to correct the trend at once. The foreman involved may be summoned to the office to go over the situation and see what corrective steps must be taken. Where the trend has not yet entered the unfavorable stage, it may be watched for a few days before any action is taken to correct it, for in some cases the situation is due to temporary factors which desappear in time doing away with the necessity for taking action.

A good example of the way the system works is the time when the expense of cleaning and removing the steel chips from the automatics became excessively high. For a while during one of the strikes at Plant "A" it was impossible to get forgings for the automatics at Plant "D", thus forcing a shutdown of all but the automatic screw machines working on small sizes. However, due to an oversight, the number of chipmen who remove the steel chips from the automatics and clean them was not cut down sufficiently. Then with the sharp drop in production, the expense of removing chips soared out of control. The trend was discovered immediately and steps taken to transfer the men to other jobs, such as

material handling.

This is the sort of fingertip control that is the goal of the present day systems of budgeting; the type of thing which is transforming the accounting field from something historical and static into a dynamic factor which management is coming more and more to realize is vitally bound up, not so much as in the past, with merely the recording of what has happened, but rather is concerned with what is happening, and what is going to happen in the future. For this reason, the accountant is becoming a more and more frequent figure in the conferences of management where policies are initiated, for it is the accountant who has the data from past transactions and experiences, and is the one who can best give management a picture of what to expect in the coming period as regards costs and expenses and their relation to expected volume of production.

APPENDIX A

The Manufacture of Ball Bearings

at

New Departure Division of General Motors Corporation

Plant D, Meriden, Connecticut

APPENDIX A

Chapter 7. The Ball Bearing

INTRODUCTION

After setting forth a few ideas concerning the theory of Budgetary Control, and discussing the application of those ideas to a ball bearing plant, a further study is appropos at this time, an attempt to fill in the background, as it were, and try to capture for the reader some of the underlying details so necessary for a complete and well-rounded picture of this case study. The layman who has never had occasion to step through the portals of a ball bearing plant can have only the vaguest idea as to the tremendous activity that goes on from wall to wall, and from basement to roof. When the outsider steps into the midst of that swirling maelstrom he is completely lost because it is nothing like what he imagined it to be from merely reading the pages of a studied report. The foremost purpose of this section is then an endeavor to acquaint the reader with some sort of impression of what goes on in the plant described in the preceding pages.

PRELIMINARY NOTES

It seems to be the academic thing to commence with a definition of the terms used, and although many of these terms have already been used before in preceding section, nevertheless for the sake of completeness we will briefly define certain important terms at this time.

According to Webster, a ball bearing is a bearing "in which

the revolving part turns upon loose steel balls which roll freely, thus doing away with sliding friction for a minimum of rolling friction."[1] The main difficulty with this definition is that it is too brief and misconceptions are allowed to creep in; and secondarily it omits the prime duty of a ball bearing - that of supporting a rotating shaft in a machine. It is unfortunate that the phrase "loose steel balls" is used, for the balls are in no sense loose. Rather they are allowed to rotate freely in the bearing, but they are held firmly in place, carefully spaced, equi-distant from each other, and held rigidly in that same relative position. From the technician's point of view, this definition limps badly.

New Departure in the book entitled "The Tale of the Tremendous Trifle" has offered a more satisfactory attempt at definition.

> "A ball bearing is a steel, ring-shaped mechanical unit containing balls, and used for supporting wheels and shafts, and for reducing friction in machinery of all kinds."[2] (See Chart C,Appen. C)

This second attempt is more accurate as a description of the purpose and functions of a ball bearing, and although it still may be lacking from the technical point of view, this latter will serve as a starting ground for the development of a discussion of the parts and processes, which discussion will act as a lengthy and more complete definition of the term.

At New Departure more than eighteen thousand different sizes

1. Webster's New School and Office Dictionary.

2. The Tale of the Tremendous Trifle, published by New Departure Division of General Motors Corporation, Page 10.

and types of bearings are manufactured, ranging from pigmies an eighth of an inch in diameter, to giants averaging a foot. There are thirty-seven operations on a bearing, exclusive of the balls, and nineteen on each ball. In addition, these same eighteen thousand sizes and types may be varied according to any one of hundreds of customer specifications, making any size essentially different from another bearing of the same size with a different spc. Finally when we include in the composite picture all the thousands of customers, each with his own particular spec, we begin to see the enormity of the task of keeping the production running smoothly, processing all the orders individually, and yet keeping them straight; and over the whole cycle of manufacturing, the cost department watching, checking, collecting data, reporting expenses and costs, and controlling the same. After one comes to know and understand it, the plant with its thousands of employees begins to acquire certain characteristics, becoming a delicately balanced organization, its humming machines being the pulse, and its cost department, the governor that controls the expenses of operation exactly and with precision.

SOME STATISTICS

And now from generalities, turn to a closer look at the bearing itself, and to certain terms used commonly at New Departure (Chart A, Appendix C). A bearing is composed of two concentric rings of steel, with balls that roll in between them. The outer ring is called the "Cup", having a groove on the inside surface along which the balls roll. The "Cone" is the inner of the two rings mentioned above, having the ballrace groove on the outer surface. The forged, ground, and polished steel Balls are assembled in the ballrace between the cup and cone. The Separator is

a steel or non-metallic device for maintaining a constant and predetermined and equal distance between the balls. It is usually a flat ring of strip steel cupped at intervals to fit the balls. One half of the separator is assembled to each side of the bearing and both are riveted together between the balls. The Seal fits over the opening between cup and cone and holds the grease inside, at the same time keeping out any grit or dirt that would shorten the life of the bearing. A piece of felt sandwiched between two flat rings of steel does the actual sealing. The Shield is similar in appearance to the seal, but does not contain any felt, its primary purpose being merely to ward off grit and dirt, and protect the balls and races from scratching or other damage due to external factors, and not to contain the grease within the bearing.

At New Departure we have other terms which are peculiar also to the bearing manufacture industry, and which are as mystifying in their meaning, to the newcomer, as the names of the different parts of the ball bearing itself. In the course of a trip through the plant one might hear of processes described as O.D.Gauge, Surface Grind, Bore, Face.

OTHER TERMS

O.D.Gauge is one of the final inspection steps prior to packing and shipping. The outside diameter of the cup is carefully gauged along its entire surface in a special gauging machine to make sure there are no eccentricities. This is very important since bearings are manufactured according to specifications of customers who desire them for installation in the housing of machines. These machines will have a recess already prepared into which the bearing will be inserted. Naturally any defect along the outer surface of the cup will result in faulty installation and

cause excessive wear to the bearing, and also to the moving parts of the machine. The Surface refers to the outside surface of the cup (See Chart A, Appendix C). The Shoulder is the inside surface of the cup, or the outside surface of the cone, exclusive of the ballraces. The Ballraces are the grooves along which the balls roll when the bearing is in operation. The inner surface of the cone is called the bore. When the bearing is installed in a machine, the bore receives the rotating shaft. The annular surface at right angles to the ballrace on either cup or cone is the Face. The size and make of the bearing is stamped on the cone face. On some sizes an Annular Groove is cut into the surface of the cup, a recess for holding a ring similar to an automobile piston ring, which holds the bearing in one position in the housing of machines. This does away with machining a special recess in the housing to receive the bearing. Certain sizes and types of bearings are designed to carry extra-heavy loads on the shaft. For this purpose, several more balls than usual may be inserted in the ballrace. A Loading Groove or notch is ground into the shoulder of the cone which allows for loading extra balls into the raceways under hydraulic pressure. Although there are other terms in common use at the plant, these are the more important ones including the more outstanding features of the bearings.

MATERIALS

Since bearings are precision-made devices, the materials that enter into their construction must be prepared according to exact specifications, so that there will be no flaws in the finished bearing, and its life will not be impaired through lack of hardness in the material. Steel alloy forms the basic material, containing different

elements in varying percentages depending upon the particular use of the finished bearing, with the emphasis upon obtaining the most efficient hardness and resistance to corrosion and wear. Consequently New Departure buys its raw material from steel mills where careful supervision is maintained over the product of the furnace. Frequent tests are made of the "heat" to see that the alloy is correct, and the Plant takes samples for further testing in its own laboratory so that there is no question but that the steel meets the requirements of the company engineers. Non-metallic material or fibre which we call Synthane is used for making the separators of certain types of bearings. Other types will take separators of carefully machined brass.

When the steel arrives at the Plant it is in the form of billets ready for the forging department, or it may be in the form of bars or tubes, by-passing the forging stage, all ready for machining. The balls are made from specially processed steel wire of varying diameters depending upon the size of the finished product. The forging process is performed where the steel is going into bearing of the larger sizes; small bearings are made from the steel bars and tubes.

In the forging department (Chart B, Appendix C), the billets are sent through furnaces of controlled temperature, heating the steel to a white hot state. Quickly the white hot metal is transferred to presses where one operation blunts the end of the billet to form a ring, another operation pierces the center making a hollow depression, a third operation cuts off the steel ring thus formed. This method of making the steel rings

or Forgings, as we call them, produces the toughest metal. The forgings are now ready for machining.

The bar and tube stock is purchased from the steel mill in the required finished state, ready to enter machining. It is kept in storage sheds until such time as the machining department requires the stock.

Other material that enters into the manufacture of ball bearings is the steel wire for the balls. This is forged in the cold state by presses. In the first operation a slug or small segment of wire is cut off; in the second operation the slug is swaged or pressed into the rough shape of a ball. From this operation the ball goes to the refining steps, a number of grinding and hardening operations, polishing, and finishing steps. The separators are made from strip steel that arrives at the Plant looking like ribbon wound on huge spools, the width depending upon the size of the separator. It is held in stock until ready to go to the pressroom.

Although when the visitor goes through the plant and sees row upon row of storage bins, and lines of machines with pans of bearings of SIZES all sorts and sizes, thousands of them, arranged beside them, and all moving toward the final operation and shipping point, the visitor no doubt wonders if there is any sort of order to the sizes that he sees on each pan, or if someone simply drew an assortment of figures out of the air and stuck them on the end of the pan. Actually a definite system is worked out so that the bearings as they start through the plant have the basic

size designation; but as they progress from one stage to another, and at each point have another feature added, a recess, notch, groove, then a digit or letter will be added to the basic size indicating that the bearing has passed that stage of manufacture. Variations will be made in the basic size according to a predetermined system, a 3200 will become a 7500 when a recess is added for a shield, or an 8500 if a seal recess is machined into the cup. Certain bearings will acquire letters having special meanings, for example WC will be added to some sizes having a wide cup with special recess for certain types of seals. A shield that we call "crow-type" is applied to some bearings, and these will carry the letter "c" before the size, indicating special machining to accomodate that style of shield, c77500.

The principle series are 1100, 1200, 1300, 3200. The first two digits from the left indicate the series, the last digit indicates the bore diameter. The next larger bore size would be 1101, 1201, 1301, and 3201. These bearings are single row, have the same general outward appearance, and vary principally in the bore size. Certain bearings are designed with a very thick cup; they fall into the 3300, 3301, series. The 1100, 1200 and 1300 series are for very heavy duty, carrying three extra balls in the ballrace. These bearings require an extra loading operation on a hydraulic press, the balls being inserted through a load-in groove, as mentioned previously in this chapter. 3200-3206, 3300-3305 are considered small sizes. Bore sizes above these are done on the large assembly and machining units.

The above series are the general all-purpose bearings. However some bearings are specially designed for particular conditions or purposes: for installation in a machine where there is angular thrust, thrust in one direction only, thrust in two directions. Others may be installed in instruments, or machines where the emphasis is on precision down to the finest degree. Tolerances instead of being 1/10,000th of an inch, will be 1/100,000th up to 1/1,000,000th of an inch. (The diameter of the human hair is 3/1,000th of an inch). Angular thrust bearings fall in the 20200 series. Where they carry a synthane separator the designation of 0L00, 0L01 is given them. One shoulder of the cup is partly ground off so that expansion of the cup on the electric hot-plate allows the balls to slip into the raceway, and when the cup cools the assembly will not come apart. The so-called Magneto bearing, ND series, ND5, ND8, is designed to carry one-directional thrust only. One shoulder of the cup is ground off allowing a large number of balls to be inserted into the cup as a cone-separator-balls assembly. Some sizes call for a brass separator, and other sizes a steel box-type separator (ND5-P takes the brass type).

The bearings discussed heretofore have all been of the single-row type - that is, they contain a single row of balls. This sort of bearing can carry loads up to a certain point, but where extreme loads are specified, and the shaft must be retained rigidly in place, and also where there is tremendous longitudinal thrust, a bearing is designed with a double row of balls. Such bearings go into the differential mechanism of automobiles. 5200, 5201 series have the ordinary thickness of cup, 5300, 5301 carry the extra-heavy cup. Where a shield is installed, the

size designation changes slightly to 5500, 55500, depending on whether they contain one or two shields. For those that have an annular ring, a 4 precedes the size, 455502.

Instrument bearings come in various series and miscellaneous sizes. Probably most of the production is in the R series, or rivet-type bearing, R2, R3, R4. Instrument bearings are assembled in air-conditioned rooms, where the temperature is kept at a constant level, and the air is cleansed of all moisture and dirt or lint by being filtered through oil. The operators wear special rayon uniforms, rayon caps, and kid gloves on their hands. They enter and leave the room through an ante-chamber that acts as an air-lock preventing the ordinary air of the plant from entering and contaminating the room. The bearings are kept in jars filled with special oil; and when they are lying on trays preliminary to handling, they are covered with cellophane sheets. The air-conditioned rooms are constructed one over the other so that the bearings once they enter the rooms never leave the pre-conditioned atmosphere until they are packed in oil-filled jars ready for shipment. Dummy-waiters transfer the bearings from one floor to the next, always inside the air-conditioned rooms. Other instrument bearings are the PF4 and C270, whose balls are so small that a teaspoon can hold 10,000 of them. These ultra-small bearings are handled under a microscope during the final operations, the girls being rotated on the job so that the strain of the exacting task will not reduce their efficiency or prove too great for their eyes. The various series and sizes thus far mentioned comprise the bulk of the most important sizes, and yet when one scans the production schedule for the plant

the diversity of the sizes and their great number make the task of enumerating series and sizes almost superhuman. It is perhaps more to the point to say that the sizes mentioned above account for many of the bearings which carry the heaviest production.

When a customer submits an order for bearings, the plant engineering department along with the engineering department of the customer SPECS will study the bearing requirements of the customer, the load to be carried, the revolutions per minute of the machine, factors which may have a corrosive effect on the bearing (water, fumes) or tend in other ways to shorten the life of the bearing (vibration). In addition they will study the type of grease or oil most suited for lubrication. It may be that the machine will be located in some inaccessible spot, so that the customer will desire a bearing that has life-time lubrication built into it through the latest type of seal. If the final bearing installation will be made in some distant spot, where climate will be able to affect the bearing, then it will be found desirable to designate a certain packing in which the bearing will be shipped. All these requirements are resolved into a legend which will tell the plant production department just what the customer wants down to the finest detail of maximum and minimum tolerances, end-play, radial-play. Rust-resistant finishes may be in order. The specification goes along with the customer's order number, quantity, and size of bearing on every tray or pan that carries the bearings from the beginning of machining right down to the last handler in the shipping room. Every time the bearings are inspected, the inspection must tally with the specifications. In this way customer satis-

faction and high-grade performance of the bearings are ensured.

As previously mentioned in the introductory chapter, certain operations are carried on only at Plant A, Bristol, Connecticut: forging, and the various productive steps in the manufacture of the balls that go into the bearings. When the forgings arrive at Plant D, they are ready for machining. The balls arrive already packed in ball boxes ready for the operations in Assembly Service. They are sent directly to the ball crib for storage until ready for assembly. Bar and tube stock is stored in sheds until time for machining, and the same thing is done with the strip steel ribbon for the separators. Synthane and brass separators are purchased ready-made from manufacturers. The above includes the principle materials that enter the manufacturing process at Plant D, and locates them for the reader, ready for the first process.

PRINCIPLE MACHINES PLANT D

Machining the cup and cone requires two basic types of machines, the automatic screw and the chucking machines. To the former go the bar and tube stock, and to the latter go the larger diameter forgings. It seems needless to describe the working and the appearance of these machines, they are mentioned largely for the sake of completeness. Grinding is performed on hand-fed, electrically driven machines, for the larger sizes called "ponies", and for the smaller sizes "rivet grinders". Lapping, a productive operation during which the ballrace is polished, is done on special electric machines designed for the purpose. The honing operation is performed on some sizes of cones either to correct previous defects in the bore surface, or to bring the inside diameter down to a closer toler-

ance. The Company is experimenting further with this operation with a view to extending its use in the plant. Assembling is performed on a loading machine which places the balls in the cup and cone. Spacing machines position the balls properly in the ballrace. At this point a check is made of the end-play to see that it is within the required maximum and minimum demanded by the specification. Arbor presses rivet or staple the two halves of the separator together. Greasing machines inject the exact weight of grease into the bearing as required by the specification. In Final Inspection a last check of various tolerances is made on gauging machines, presses assemble seal and shield on the bearing as required by the size indicator, greasing and oiling machines make the bearing ready for the shipping room. The separators are stamped out in the Pressroom where presses of various design perform the necessary productive operations. The steel ribbons are sent through one press which stamps out separator blanks at the rate of over one hundred a minute. Another type of press shapes the blanks so that they will fit around the balls in the bearing. Still another type of press assembles rivets in the A-piece where rivets are used to hold the separator halves together in the finished bearing. The final operation is the tumbling barrels where the burrs are removed from the separators.

Plant D has a fultering plant where the oils and grinding compounds are renewed and cleansed after passing through the various operations. Different types and weights of oils are used in the various machining operations, depending upon the hardness of the material and the type

of machine being used. The oils and compounds are piped through the building to the departments and the machines where they are used. The dirty oil and compound then flows back under gravity to the filtering plant where it is renewed and sent back through the system again. Constant supervision keeps waste at a minimum. Oils are pumped to the machining operations where it keeps the cutting tools from overheating on the automatic screw and chucking machines. Other types of oils are sent into departments where there are hand-operations. The bearings are given a bath of oil to preserve them from rust after handling. Bearings are also coated with oil before storing. Solvents are used to clean bearings of grit and moisture accumulated as they pass through productive operations, especially grinding and lapping where abrasives are used. The grinding compound is a milky-white liquid applied in a continuous stream to the bearing at the point of contact with the carborundum wheel. The compound prevents the wheel and bearing from overheating. Lapping pastes are applied to the ballrace by the operator during the operation. Depending upon whether it is first, second, or at times third lap, the paste contains abrasives of a greater or lesser degree of coarseness.

OILS, SOLVENTS
GRINDING COMPOUNDS
LAPPING PASTES

Men and machines, raw materials and supplies, these are the factors with which the Cost Department works, setting budget standard, and controlling cost.

Chapter 8. Productive Operations For the Manufacture of Ball Bearings Plant D

We turn more particularly now to a consideration of the productive operations carried on at the Meriden factory, Plant D. Up to this point certain operations have already been described.

PRELIMINARY NOTES

In Chapter 7 we considered very briefly the upset forging method; also in the same chapter we saw how the balls are made. These operations are carried on in the Forge Plant and Ball Plant at the Bristol Factory, and the forgings and balls are transported to Meriden for the finishing operations, "refining", as we say at Plant D.

Daily huge dray trucks transport to Meriden the forgings loaded in large, steel, portable bins. At the unloading platform, electric plant trucks remove the bins from the drays and carry them directly to the Machining Department.

MACHINING

In the case of the smaller sizes, bar and tube stock is picked up from storage and brought to machining by plant truck. From this point on, forgings, bar, and tube stock are handled in the same fashion right up to the shipping point.

As the visitor steps into the Machining Department, he is met with a terrific dinning clamor, a never-ending roar, which he recognizes as the distant sound he heard a block away from the plant even before he arrived at the front gates. There before him are row upon row of machines

each one adding its voice to the general uproar, billowing clouds of hot oil vapor into the misty air. As he becomes accustomed to the room, he begins to see that all is orderly, neat, and clean, in spite of the turmoil of activity going on. The floors are clean-swept, aisles are clear, material is in its proper place beside each machine, within easy reach of the operator, fresh sawdust was sprinkled on the floor around the machine at the beginning of the shift to make the footing safe, tools are kept on a small table along with necessary gauges for checking the work as it comes off the chuck. Here there is a set-up man re-setting the tools in a machine for a new run of work, over there another is checking the work of an operator, because the machine seems to be slightly out of adjustment.

In the chucking section, each operator handles four machines, putting a fresh forging into the chuck, taking away the filled pan of work and piling the pans at the end of the aisle for the material handlers to remove, checking each cup or cone as it comes from the machine, inspecting for damage to the cutting tools, or maladjustment resulting in improper tolerances in the work. Two cups or cones are machined from each forging necessitating that the forging be run through the machine twice. The excess material is cut down to approximate dimensions, a rough gauge. Fine tolerances will be finished in the grinding department. The surface is cut down, face, shoulders, raceways, recess for shield or seal where the order calls for it. All these operations are done in the same machine, in one complete cycle. Material handlers pick up the completed work in pans and take it to the washing machines that clean away loose chips of

steel. From there the work is sent to the kitty (machine storage) to stay until time for grinding.

When the production schedule calls for it, the cups and cones are removed from the kitty in the basement, and taken by elevator to the fourth floor of the building, and from there work their way down by stages from department to department and floor to floor until they arrive at the shipping platform on the ground floor. The cups go into surface grind, and the cones into shoulder grind. This operation is very important for in succeeding operations any eccentricities that appear in this department will show up also in the succeeding stages (except face grind) since positioning the work in the chucks in later steps can be traced back to this department. The surface of the cup and the shoulders of the cone are ground down to the tolerances required in the customer specifications attached to the lot. The work is carefully checked, and the machines watched closely to discover any trouble at the earliest possible moment.

SURFACE DEPARTMENT

The faces of the cup and cone are next ground. In this operation a revolving carborundum disc grinds off the excess material until the red crayon comes off the face of the master cup or cone in the center of the work. The work is turned over and the same is done on the other side. The cones are then taken to the stamping machine where "ND (size) MADE IN USA" is stamped into the face. The Final Inspection Department has located in Surface a small section that inspects and gauges all the bearings before they leave the department to ensure that there are no

defects in the work, and that it is 100 percent acceptable according to the standards set up by the engineering department.

Up to this point in the manufacture, the bearings have been handled in the soft state, as they came from the annealing department at Plant A. But before they can be finished, they must be hardened so that they will have long life, and good wearing qualities. If they were sent to machining in a hard condition, the cutting tools would be quickly dulled making that process very expensive. But now the bearings are sent to Heat Treat where in furnaces of controlled temperature they acquire such great hardness that only the toughest abrasives can scratch their surface. The cups and cones now give forth a clear ringing sound when they are passed from one pan to another during handling.

HEAT TREAT

The cones leave Heat Treat and travel to Cone Bore Grind, on the third floor, the cups going to Cup Grind on the fourth floor. The grinding operations, and lapping, too, for the ballrace are the same for cup and cone, with minor variations in the design of the machines used to take care of the opposite position of ballrace between cup and cone. Here, we will describe the operations for grinding the cups. If, in the preceding steps, it was important to have tolerances very exact when cutting or grinding down surfaces, so much the more so is it important when the ballrace is ground. It must be as nearly perfect as scientific engineering can attain, since the ballrace is the very heart of the bearing, it must maintain contact with the balls with absolute trueness throughout its circumference; otherwise vibrations will

CUP BALLRACE GRIND & LAP

set in, and excessive heat will be generated shortening the life of the bearing.

The cup is placed in a chuck which holds it by the surface and rotates it at 800 revolutions per minute in a direction opposite to that in which the carborundum wheel is moving. The chuck is in a head which slides up to the wheel at the start of the grinding, and when the operation is complete automatically slides back again away from the wheel. The carborundum wheel is set in a head that swings back and forth during the grinding operation bringing the wheel in contact with the ballrace from shoulder to shoulder of the cup. This swinging motion in conjunction with the regular rotation of the wheel at 2,000 revolutions per minute is necessary to ensure a ballrace that is absolutely true. The wheel rotates in a direction opposite to that of the cup so that the work done is speeded up by 800 times 2,000, cutting down the time necessary for the cup to remain in the machine. An electrically operated micrometer checks the diameter of the ballrace when the work is half completed and again when it is fully ground, shutting off the machine, and returning the chuck to the rest position so that the cup can easily be removed and a fresh one inserted without excessive movements on the part of the operator. Each operator controls six machines, moving back and forth up and down the line. When he is able to make production, he reaches each machine as it automatically shuts off and returns to rest, thus losing no time himself, and not allowing the machine to remain idle for any time at all. The operator removes the cup from the machine, inserts a new one, and gauges the one just removed to make sure the wheel is grinding true. Material

handlers bring the work to the machine and take the finished work away to be washed and sent to inspection. Here again Final Inspection maintains a branch of the department, checking all the work as it leaves the machines, inspecting the ballrace for flaws, scratches, gauging the diameter of the ballrace, and checking the entire cup in general for any defects.

After the ballrace has been ground, its surface will have tiny microscopic scratches in the raceway. Although these may not be visible to the naked eye, they will cause excessive wear and overheating while the bearing is in operation. Consequently, it is necessary to polish the ballrace surface with a lapping paste containing a fine abrasive, removing any scratches due to grinding. Some bearings are lapped twice, and those having Perfex or Ultra-Perfex specifications will be lapped three times. A different paste is used depending whether it is first, second, or third lap. After lapping the ballrace is again inspected and gauged and the bearings are sent to Assembly Service for the first step in the assembly operation. The cones having gone through the same grinding and lapping process also arrive at Assembly Service where they meet the cups.

ASSEMBLY SERVICE

Due to very fine variations in the texture and hardness of the material in individual cups and cones and balls, it is impossible for a set-up man to adjust a grinding or lapping machine so that it will take off exactly the same amount of material from each succeeding cup or cone or ball. Consequently when the parts are gauged, very slight differences in the measurements show up. As long as these

differences are within certain maximum and minimum limits, the cups are not rejected in the preliminary operations but are sent along to the present department, and here the parts are gauged very carefully as to ballrace diameter, and sorted by fractions plus or minus the desired diameter. The same phenomenon is true of balls which may run 5/16 of an inch plus or minus .005 or .0005. The engineering department in conjunction with the customer will specify that the completely assembled bearing will have a certain looseness between the parts called end-play. Maximum and minimum limits from a standard are set, and the completed bearing must conform to those specifications. However due to these slight variations in the diameter of the ballraces of cup or cone, and due to the same variations in the balls themselves, it is not possible merely to grind the parts to a certain diameter and then assemble them and expect that as they come off the assembly line, they will all conform to the proper standards. Instead it is necessary first to trial assemble the cup and cone with a few balls and then check the end-play to see that it is correct. This process is called Matching, because several trials may be necessary before the proper size ball is found for the cup and cone. A plus cup and a minus cone will need a plus ball of greater diameter than a plus cup and a plus cone. Charts have been devised for the operators indicating what sized ball is necessary for the various combinations of plus and minus cups and cones, so that the work takes less time than it does to describe. Sorting of the cups and cones into plus and minus so many fractions simplifies the work still further, so that only occasionally for any batch of work is it necessary for the operator to match cup, cone, and balls more than just to spot check. Once the necessary parts have been

gathered together, cups and cones are placed one inside the other on trays and a small steel box containing sufficient balls to assemble the lot is placed on top. The parts are now ready to be assembled.

ASSEMBLY DEPARTMENT

The Assembly Department is one of the more interesting parts of the plant, for here one becomes acquainted with every size of bearing, and can see every bearing grow to completion before his eyes.

The number of operations here are many and varied, and it seems to the casual observer that no two types of bearings are assembled in the same fashion. This is due mainly to variations in the structure of the bearing itself. It is not the province of this paper to discuss all of the operations in detail, nor to give a complete picture of the entire department. Consequently we will limit ourselves to a brief survey of the sequence of operations as followed for the bulk of the production.

Let us take for example size 3203, specification X 1223, for which the production rate is 1.000 an hour on the assembly line. The bearings arrive from Assembly Service neatly arranged on trays so that the loading operators can pick them up quickly and without fumbling. Pending their turn for assembly, the bearings are stored on shelves at the head of the line within easy reach of the material handlers, who bring the work to the operators, and take away the filled pans at the end of the line. A continuous moving belt carries the stream of bearings from one operation to the next right down the line. As each operator completes work on a bearing, it is dropped on the belt to move on to the next step. The Methods Department has devised metal chutes to reduce the movement of

the arm necessary to drop the bearing on the belt. These devices also speed production by reducing arm fatigue. Continuous studies of this sort are going on all the time through the Methods Department.

Actual assembly of the bearing begins with the loading operator at the head of the line. The cup and cone are placed in a loading machine which allows just the right number of balls to roll into the ballrace when the arm of the machine is swung by the operator. The loaded bearing is then dropped on the moving belt and goes to the spacer who inserts it in a machine that positions the balls evenly around the ballrace. After putting the A-piece of the separator in place to hold the balls spaced, the bearing is sent to the gauger who tests the endplay. If the bearing meets the requirements, it is dropped on the belt to proceed to the staker who inserts the B-piece of the separator and stakes both pieces together. The bearing is now completely assembled since no seal or shield is required, this bearing being a 3203. Those bearings which were rejected at the gauging operation are sorted on pin-boards with slips of paper showing their exact tolerances, and are sent to the reject-bench to be tested and allotted to other orders which require their end-play. Bearings which do not meet any specifications are returned to grinding or lapping to be made into other types, and those which cannot be salvaged at all are scrapped. A daily report of all bearings scrapped is sent to the Production and Cost Departments and careful control is kept to see that it does not become excessive. After staking the bearings go through a sound-proof booth where they are spun on electric motors to test for any

vibration or chatter - Noise Test. They continue on down the line from the booths to the greasers who insert the exact weight of grease specified by the engineering department. The wrappers pack the bearings in oilpaper and drop them into boxes ready for the shipping room.

This bearing is completely assembled and packed ready for shipping as it drops off the line. However the majority of the day's production will be sent directly to Final Inspection from the stakers where they will have further operations and tests performed before they will be greased, wrapped, and shipped.

FINAL INSPECTION

In Final Inspection the last tests before shipping, and the most rigid, are performed on the bearings to make sure they meet the standards set by New Departure. The seal or shield will be pressed on to the bearing, then it will go to the noise test booth, the gaugers, greasers and packers, and finally to the shipping room. Those bearings which are rejected in the final gauging operation are broken down in this department and returned through assembly possibly with a different size ball. Bearings which are being shipped at once will go directly to the shipping room. Others will be sent to finished stores to be held in reserve for high volume customers.

This chapter has given the reader an airplane survey, as it were, a brief glance into the production cycle of the New Departure ball bearing. It was not intended that this should be a complete picture of the process, but rather just an indication, a background study in the light of which

the reader can view the application of the principles of budgetary control as presented in Part II.

APPENDIX B

FORMULAE FOR DERIVING DATA

FOR THE

SALES BUDGET

APPENDIX B

Cases Indicating Uses of Various Formulae In Establishing Data For the Sales Budget[1]

Case 1. Sales Volume at which a concern will break even.

Assumptions:

Fixed Costs are $40,000, and will remain at that figure.

Present variable costs are $80,000, and the relationship of variable costs to sales will remain constant.

Present sales are $100,000.

Prices will remain fixed.

Symbols:

x - Sales Volume necessary to break even.

f - Fixed costs ($40,000).

v - Present variable (constant) costs ($80,000).

s - Present Volume of sales ($100,000).

Solution:

$$x = \frac{f}{1 - \frac{v}{s}} = \frac{40,000}{1 - \frac{80,000}{100,000}} = \$200,000$$

1. Heckert, J. Brooks, Business Budgeting and Control, New York, The Ronald Press Company, 1946. Pages 39 to 43.

Case 2. Percentage of Plant Capacity at which concern will break even.

Additional Assumptions:

Present level of production is at 30% of plant capacity.

The relationship between plant capacity and dollar sales is constant, that is, an increase of 10% in plant capacity will result in an increase of 10% in sales volume.

Additional Symbols:

x - Percentage of plant capacity at which concern will break even (unknown).

c - Present percentage of plant capacity (30%).

Solution:

$$x = \frac{fc}{s - v} = \frac{40{,}000 \times 0.30}{100{,}000 - 80{,}000} = 60\%$$

Case 3. Volume of Sales which will yield a given profit.

Assumptions are the same as above.

Symbols:

x - Sales Volume necessary to produce a profit of $5,000.

p - Profit desired ($5,000).

Solution:

$$x = \frac{p + f}{1 - \frac{v}{s}} = \frac{5{,}000 + 40{,}000}{1 - \frac{80{,}000}{100{,}000}} = \$225{,}000.$$

Case 4. Profit which will result from a given volume of sales.

Assumptions are the same as above.

Symbols:

x - Profit which will result from sales of $240,000 (unknown).

S - Proposed volume of sales.

Solution:

$$x = \left[S\left(1 - \frac{v}{s}\right)\right] - f = \left[240{,}000\left(1 - \frac{80{,}000}{100{,}000}\right)\right] - 40{,}000 = \$8{,}000.$$

Case 5. Unit costs at different volume levels.

Assumptions:

Present unit selling price is $2.00 per unit.

What would be the unit cost if sales were increased to $240,000?

Present cost of units is $2.40, that is, 0.80 fixed, and 1.60 variable costs, with 50,000 units being produced under the present conditions.

Symbols:

x - new unit cost (unknown).

u - present unit selling price $2.00.

S - proposed volume of sales ($240,000).

Solution:

$$x = u\left(\frac{f}{S} + \frac{v}{s}\right) = 2\left(\frac{40{,}000}{240{,}000} + \frac{80{,}000}{100{,}000}\right) = \$1.933.$$

Case 6. Increased Sales Volume necessary to balance a reduction in the Selling Price.

Assumptions:

A reduction in selling price of 10% is proposed.

What percentage increase in volume will be necessary to yield a profit of $5,000 if the selling price is reduced 10%.

Symbols:

x - Sales Volume necessary to produce a profit of $5,000 when prices are reduced 10% (unknown).

p - Profit desired.

s - present volume of sales (100,000).

r - proposed percentage reduction in selling price (10%).

Solution:

$$x = \frac{p + f}{1 - \left(\frac{v}{s}\right)} = \frac{5{,}000 + 40{,}000}{1 - \left(\frac{80{,}000}{100{,}000}\right)} = 405{,}000.$$

Explanation:

A sales volume of 405,000 units must be secured to produce a profit of $5,000 if prices are reduced 10%. Since this goes beyond the capacity of the plant (previously assumed to be 333,333 units), such a program is impossible without further increase in fixed costs.

Case 7. Advisability of Plant Expansion.

Assumptions:

Assume a contemplated enlargement of the plant will result in fixed costs of $60,000 instead of $40,000 as at present, and that profit of $15,000 is deemed necessary to justify the expansion.

Symbols:

x - Sales Volume necessary at present prices to produce a profit of $15,000 when fixed costs are $60,000 (unknown).

p - Profit deemed necessary to justify plant expansion.

a - Additional fixed costs.

Solution:

$$x = \frac{p+f+s}{1-\frac{v}{s}} = \frac{15,000+40,000+20,000}{1-\frac{80,000}{100,000}} = 375,000.$$

Explanation:

Therefore a sales volume of 375,000 will be necessary to justify the plant expansion.

APPENDIX C

ANALYSIS OF BURDEN

For Establishing Fixed and Variable Burden Rates

for the 1943 Calendar Year

8 Months Actual 1 Months Forecast

FORM A 99

Division: (Burden Center) DAILY PLANT REPORT

Line	Particulars Actual Expense (omit pennies)	Indirect Labor 100	Operating Expense Suppl. 200	Tools 300	Utilities Purch. 400	Maint.Rep. Rearr. 500	Employ Ins Taxes 600	Losses Errors 700	Deprec. 800	Other Fixed Chges. 800	Total Fixed 800	Sundry Mfg Exp 900	Credit A/c 1000	TOTAL MFG EXPENSE	Actual Net Prod Labor
1															
2															
3	March														
4	April														
5	May														
6	June														
7	July														
8	August														
9	September														
10	October														
11	November														
12	December														
13	Less: Actual net premiums on Productive Labor														
14	Total Actual plus forecast														
15	Less: 1942 Fixed and non-variable (actual)														
16	Variable Burden - Actual														
17	Adjustments to 1942 Variable Burden - Sched. E.														
18	1942 Adjusted Actual Variable														
	Variable Rates														
19	1942 Standard Rate Calendar Year Study														
20	1942 Actual (16÷Prod Labor Line 14)														
21	1942 Adj. Actual (18÷Adj Prod L)														
22	1943 Proposed Variable Rates														
	Fixed and Non-Variable Burden														
23	1942 Model Yr. Study (Annual)														
24	1942 Calendar Yr. Study (Annual)														
25	1943 Proposed														
	Non-Variable Personnel														
26	1942 Model Year Study														
27	1942 Calendar Year Study														
28	1943 Proposed														
	Comparison of 1943 Budget with 1942 Adjusted Actual														
29	1943 Budgeted Var. (22×Prod L 18)														
30	Variable Savings (18 - 29)														
31	Fixed and Non-Variable Savings (15 minus item 1 of Sched.E minus 25 for same no. months as in 15)														
32	TOTAL SAVINGS 1943 over 1942														

SCHEDULE OF ADJUSTMENTS
FOR ESTABLISHING VARIABLE BURDEN RATES
for the 1943 Calendar Year

SCHEDULE E

FORM B 100

Division _____ (Burden Center) _____ DAILY PLANT REPORT

Description	100	200	300	400	500	600	700	900	1000	TOTAL MFG EXPENSE	Actual Net Prod Labor
1. Transfer of employeas from non-variable to variabla and vice versa											
2. Variabla Hourly Wage Increase for period_____											
3. Variabla Salary Adjustments											
4. Other Adjustments											
5. Non-Recurring items - 1942											
6. Non-Recurring items 1943											
7. Total to Line 17 Schadule D											

FORM C

BURDEN ESTIMATE

Schedule F

Period From _____ To _____

Burden Center _____ Plant _____ Division _____

Standard Volume _____ Index Volume _____

Units _____

Productive Hours _____

Av. Hrly Rate per Std. Hr. _____

Productive Labor _____

STANDARD VOLUME

	Variable Burden				Fixed and Non-Variable		Total Burden	
	Rates			Amount	Amount			
Accts.	Direct	Gen'l Plt.	Total	Total	Direct	General Plant	Amount	Rate
100								
200								
300								
400								
500								
600								
700								
Deprec.								
Taxes								
Sp. Fac								
Other								
Total 800								
900								
1000								
Total								

Burden Rate Actually used for Costing - Variable _____

Fixed and Non-Variable _____

Total _____

Omit Pennies

Show all rates per $100 of Productive Labor, two places to right of decimal

Date Prepared _____

Form E. Daily Plant Report

GM 37 REV. 4-3-46 LITHO. IN U.S.A.
6 6

DAILY PLANT REPORT

GENERAL MOTORS CORPORATION

PLANT _____ DIVISION _____ DATE _____

	TODAY					MONTH TO DATE		
	TOTAL ACTUAL BURDEN	DEDUCT FIXED	ACTUAL VARIABLE	STANDARD VARIABLE	SAVING	SAVING	VARIABLE RATE ACTUAL	VARIABLE RATE STANDARD
INDIRECT LABOR								
OPERATING SUPPLIES								
EXPENSE TOOLS								
UTILITIES PURCHASED								
MAINT. & REARRANGEMENT								
EMPLOYES INS., TAXES, ETC.								
LOSSES, ERRORS, DEFECTS								
FIXED CHARGES								
SUNDRY								
CREDITS								
TOTALS--BURDEN								

	TODAY	MO. TO DATE	YR. TO DATE
ACTUAL PROD. LABOR			
STD. PROD. LABOR			
SAVING--LABOR			
SAVING--BURDEN			
TOTAL SAVING			

OVERTIME AND NIGHT SHIFT PREMIUMS (MEMO ONLY)

	TODAY	MO. TO DATE	YR. TO DATE
OVERTIME-HOURLY			
OVERTIME-SALARY			
TOTAL NIGHT SHIFT			
TOTAL PREMIUMS PAID			

EXPLAIN UNUSUAL ITEMS, ADJUSTMENTS, ETC. ON REVERSE SIDE

DATE ISSUED

FACTORY MANAGER

(Form F. Budget Performance Worksheet)

M-100 FORM G. BUDGET PERFORMANCE

Dept. _____
Week Ending _____

DIRECT LABOR

Oper.	Actual Money	Std. Money	Var.	Actual Hours	Std. Hours	Var.
Total						

INDIRECT LABOR

Acct. No.	Description	Actual Money	Std. Money	Var.	Actual Hours	Std. Hours	Var.
110	Supervision						
120	Clerical						
130	Mat'l Handling						
140	Property Attendants						
151A	Set-up & Supervisors						
160	Drafting						
180	Inspection						
191	Utilities Service						
193	Welfare Attendants						
199	Sundry						
Total							
7121	Scrap						
7221	Refinish						
760	Time Allowed						
Total							

Memo.

Form H. Weekly Labor Report

M-99

WEEKLY LABOR REPORT

Dept. Name Date

Acct.	Description	Actual	Std.	Var.
110	Supervision			
120	Clerical			
130	Mat'l Handling			
140	Property Attendants			
151A	Set-up & Supervisors			
160	Drafting			
180	Inspection			
191	Utilities Service			
193	Welfare Attendants			
199	Sundry			
Total				

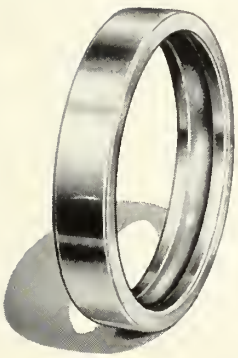
Pennies Omitted

Standard Productive Hours	
This Week	
Last Week	

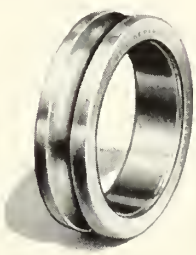
Memo.

CHART A

How Balls are used

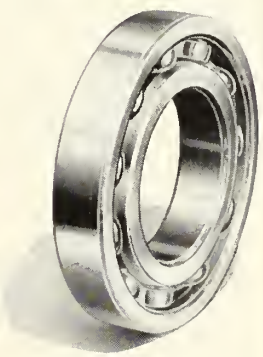


Outer ring of ball bearing showing the accurately ground and lapped ball groove or raceway.



Ball bearing inner ring which has corresponding ball raceway on the outside.

Set of balls and the two halves of the separator or ball cage which spaces the balls in bearing.



Completely assembled New Departure Ball Bearing, ready to be mounted in machine.

in a Ball Bearing

A ball bearing consists of two very hard and tough steel rings, one held concentric within the other by a number of equally spaced steel balls which roll in grooves in the rings.

When one ring is fixed on a shaft, and a wheel or other part is fitted over the other ring, the wheel will revolve on a circle of free rolling balls. Such a bearing will not only resist radial and thrust loads, but will do so with less friction than any other type of bearing.

In the rotating parts of millions of vehicles and machines of all kinds, New Departure ball bearings are playing a vital part in reducing friction and preventing wear.

THE PARTS OF A BALL BEARING

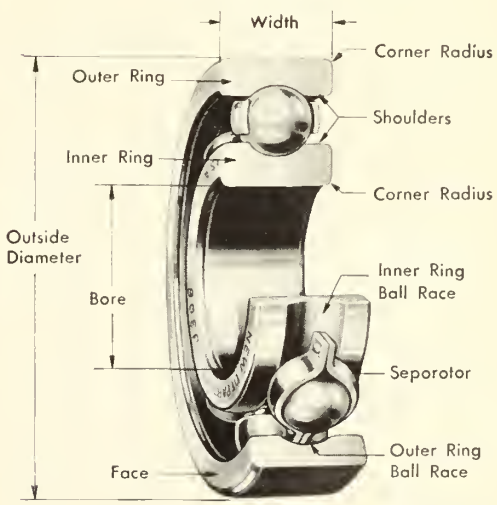


CHART B

FORGED

for

Strength

•

Endurance

•

Uniformity

New Departure Combined Plants

Superfine Steel

New Departure electric furnace alloy steel, the finest ever developed for hearings is subjected to the most critical laboratory examinations both *before* and *after* rolling into forging hars.

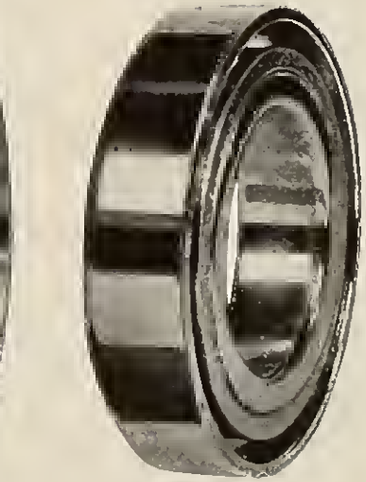
Endurance Forged In

In one of the largest, hest equipped Forge Plauts of its kind, New Departure shapes the hearing parts hy *forging* — not ouly huilds greater strength, toughness and resistance to wear, hut secures for the hearings the vital factor of *uniformity* which is the basis of reliability.

FORGING NEW BEPARTURE BEARING RINGS, AS SEEN BY
HERBERT M. STOOPS, WELL KNOWN ARTIST

Precision Manufacture

Every step in manufacturing New Departure Ball Bearings is under precision control, designed to assure the greatest accuracy, endurance and uniformity by ultra-modern, scientific methods.



Forging Fights Fatigue

Normal hearing life is terminated only hy *fatigue* — which is uot a surface phenomenon, as some have thought. Fatigue starts *below* the surface, where New Departure's forging-coutrolled grain flow combats it, delays its occurence, gives longer hearing life under heavy loads

CHART B

New Departure Steel Balls

Some of the Manufacturing Operations

1. Section of heat-treated high carbon chrome steel ball rod ready for forging.

2. Rough formed ball after forging and ready for the next heat-treating operation.

3. After first rough grinding. This is preparatory to increasingly accurate grinding that follows.

4. After hardening, the ball is tempered to give great strength without materially affecting hardness.

5. The finish ground ball is accurate, but requires further surface processing for extreme precision.

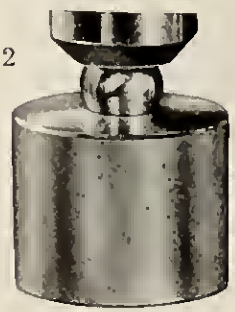
6. After final lapping and polishing, a New Departure ball has a mirror finish—is marvelously accurate.

Great Strength of Balls

Forged by

New Departure

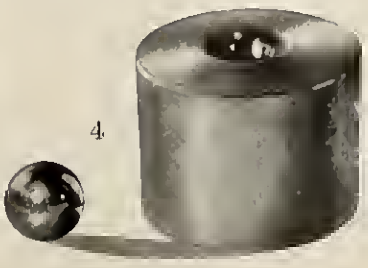
1. New Departure high carbon chrome steel ball and solid steel block.



2. Applying pressure with hydraulic ram. Ball on its way into block.

3. Pressure reaches 180,000 lbs.—90 tons—nearly capacity of testing machine.

4. Out, round and good for more tests. Block distorted and cracked.



Cutaway view New Departure Self-Sealed Ball Bearing.

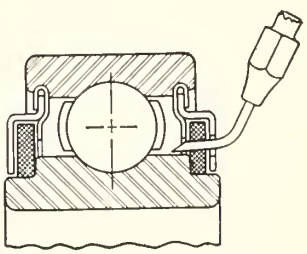
Still lubricated for life

. . . now has a new plus feature

In the majority of applications you can install it—and forget it—because this bearing is, for all normal conditions, *lubricated for life,* with dirt sealed *out* and the lubricant sealed *in.*

But *now*—for the *unusual* applications—where excessive heat or other abnormal circumstances were formerly too tough for a single supply of lubricant, these bearings can be relubricated quickly and easily. There is no removal of seals—no nipples, grease passages or plugs required.

Thus, this one type of New Departure Self-Sealed Ball Bearing gives you dependable performance for *both ordinary* and *unusual* conditions, extending its use to *many additional* applications. New Departure originated the self-sealed bearing. Over 110 million are in successful operation. For further details, ask for booklet IB.



In most applications you never need relubricate a New Departure Self-Sealed Ball Bearing—because it is lubricated-for-life.

When operating under the abnormal conditions described at left, you may, at infrequent intervals, relubricate as follows:

Simply insert the "hypodermic" nozzle of the lubricating gun through small hole in seal member. Nozzle penetrates the flexible inner seal, cleaning itself as it enters. Lubricant is injected and hole in seal closes completely as nozzle is withdrawn. No dirt can get in.

UNITED SERVICE MOTORS

Nation-wide replacement and small order service, wherever you see this sign.

nothing rolls like a ball

NEW DEPARTURE

BALL BEARINGS

3450-C

NEW DEPARTURE • Division of GENERAL MOTORS • BRISTOL, CONN. • Branches in DETROIT, CHICAGO, LOS ANGELES and Other Principal Cities

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Budgetary control in a manufacturing concern.

DATE	ISSUED TO
3 -	Mary Ann F

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